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TRANSACTIONS

OF

THE ESSEX FIELD CLUB.

Vol. III.

S.22.A.

LONDON:

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HATTON GARDEN, E.C.

TRANSACTIONS

OF THE

ESSEX FIELD CLUB.

EDITED BY

WILLIAM COLE, HONORARY SECRETARY.

VOLUME III.

FEBRUARY 25TH, 1882, TO JANUARY 27TH, 1883.

"*Come forth into the light of things,*
Let Nature be your teacher."—WORDSWORTH.

THE AUTHORS ONLY ARE RESPONSIBLE FOR THE STATEMENTS AND OPINIONS CONTAINED IN THEIR RESPECTIVE PAPERS.

BRITISH MUSEUM
NATURAL HISTORY

PUBLISHED BY THE CLUB,
BUCKHURST HILL, ESSEX.

1884.

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TRANSACTIONS

OF

THE ESSEX FIELD CLUB.[1]

I.

The Ancient Fauna of Essex.

By Henry Woodward, LL.D., F.R.S., F.G.S.,
Keeper of the Department of Geology, British Museum (Natural History).

[A Lecture delivered to the members of the Club, at the British Museum of Natural History, South Kensington, on Saturday, May 13th, 1882.]

The Essex Field Club is fortunate in being located in a suburban district where an open space is reserved of a larger extent than that of all the parks and pleasure-grounds of the metropolis united. Six of the larger parks combined do not contain more than 1800 acres, whereas Epping Forest still claims between five and six thousand acres. To your Society now belongs in some degree the task of jealously guarding for the public that wide tract of woodland which has been so munificently bestowed on the people of London. The trees and wild plants need friendly care and fostering, and if, as it is to be hoped, our native song-birds and animals are to have a fair chance of existence, "nor gun, nor snare, nor limed twig" should be permitted by the Conservators and Verderers within their domains.

[1] [Much inconvenience having been occasioned in cataloguing and referring to our publications by shortened titles which by no means represent the scope of the Society, the Council has authorised the Editor to use the above words in future in the 'Transactions' and other issues of the Club. Writers and cataloguers making references to our publications are requested to quote them as "Transactions" or "Proceedings" (as the case may be) of "The Essex Field Club," the present part being the commencement of the *third* volume.—Ed.]

Even among the members of a Naturalists' Field Club there is at times no doubt a tendency to become the unintentional extirpators of some rare plant or insect when the resort of the one or the *habitat* of the other has been made public in its Proceedings.

But there must always be a wide distinction drawn between the true Naturalist and the ordinary collector. I earnestly trust that you all belong to the former type, and, if you collect, you will be careful not to exterminate a species for the mere purpose of obtaining duplicates for exchange.

I wish now briefly to refer to the historical records of Epping Forest and the neighbouring area, so far as I have been enabled to gather them.

So lately as A.D. 1700 the entire tract between the rivers Roding and Lea was forest-land, the greater part covered with timber.

In the Notes to Bowen's Map of Essex (1743) it is stated, "Epping Forest was formerly of very large extent, but its limits were settled and restrained by Act of Parliament (17 Car. I.), according to which regulation it is now about fourteen miles long and ten broad. 'Tis full of game, and well stocked with deer, said to be the largest and fattest in the kingdom."

Epping Forest, with the neighbouring forest of Hainault, which was disafforested about thirty years ago, was originally called the Forest of Essex, or the ancient Royal Forest of Waltham. It is said to have extended at one time over a very vast district, including in the reign of Henry III. (1228) almost the entire county of Essex; while in the reign of Edward I. (1298–1300) the perambulation, if correct, comprised lands running down to the townships of Havering, Dagenham, Barking, and other places in the neighbourhood of the Thames. In the reign of Henry II. (1154), the Forest of Middlesex extended from Houndsditch to about twelve miles north of London, and belonged to the Corporation of the City of London. The Forest is described as abounding in Wolves, Wild Boars, Stags, and Wild Bulls. So late as the time of Henry VI. (1485), Wolves were met with

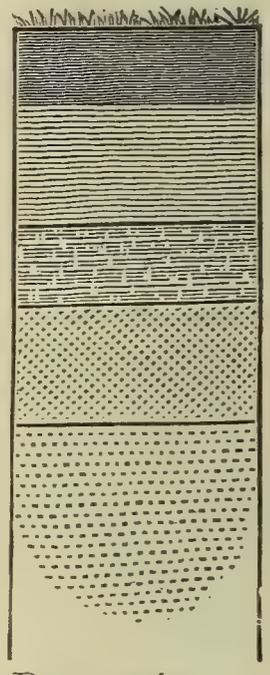
there. This tract was not disafforested until 1777 (17 Geo. III. c. 17). Chapman and André's Map of Essex (1777) is the earliest accurate map of this county, and shows at least a portion of the tract under consideration still covered with forest-trees, and styled "Walthamstow Forest." Indeed so late as the first Ordnance Survey Map (published in 1805) the "Lower Forest" extended close to Maryland Point, Stratford.

Turning from the written evidence of the Epping Forest district, it is of no small interest to ascertain what can be learnt from the unwritten records of prehistoric times which have been preserved to us in the ancient and modern river-valley deposits, the brick-earths, shell-marls, and peat, so characteristic of large portions of this area. Bearing in mind the former continuity and extent of Epping and Walthamstow Forests, and the very recent date at which a large part of this area has been enclosed and cultivated, we can the more readily understand how it has happened that such interesting prehistoric remains as are here met with, only a few feet below the surface, have remained hidden for so many centuries, undisturbed by that most restless of all beings—Man,—to be unearthed at this time, when their interest can be appreciated and their significance understood.

The best illustration of the remains of the more recent fauna of the river-valleys of the Lea and the Roding was that exposed in the district of Walthamstow, which, in 1868–69, was laid bare by the East London Water-works Company in preparing their large filter-beds and reservoirs, which extended from the Lea Bridge Road in a northerly direction beyond Tottenham Railway Station, and occupied at that time the area marked on the maps as Walthamstow Forest. Their works in 1869 covered more than one hundred acres, the depth of the general floor nowhere exceeding ten feet; but the trenches made for the "puddled walls" in the centre of the artificial embankments went down to a depth of twenty to twenty-four feet. The subjoined sections, taken by me in the summer of 1869, will serve to show the nature of these deposits:—

Sections exposed during the construction of the Reservoirs of the East London Water-works Company, at Walthamstow.

Fig. 1. — Section at the South-east corner of the Eastern Reservoir :—



Bed No. 1. Surface soil, 12 inches . . .

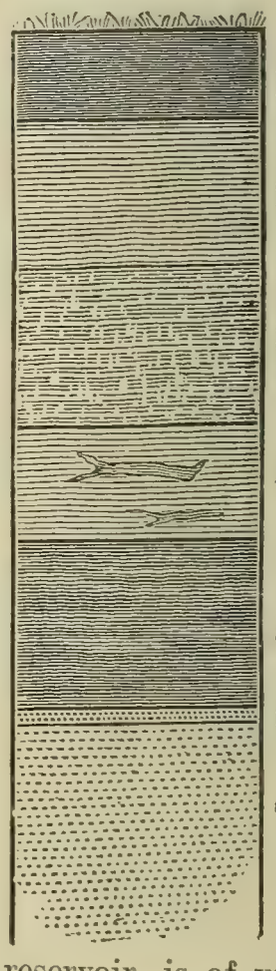
„ 2. Clayey loam, 18 inches . . .

„ 3. White shell-marl, 10 inches .

„ 4. White-coated subangular gravel encrusted with lime from superimposed shell-marl, 18 inches.

„ 5. Rounded and subangular gravel[2] stained with oxide of iron (actual depth not ascertained).

Fig. 2.—Section at South-west corner of Reservoir :—



Bed No. 1. Vegetable mould, 12 inches.

„ 2. Stiff brown clay, 24 inches . .

„ 3. Shell-marl and marly clay, 12 to 36 inches . . . . . .

„ 4. Stiff dark clay, with wood, 18 inches . . . . . .

„ 5. Peat, 24 inches, lying on. . .

„ 6. Thin band of black gravel stained by overlying peat, 3 inches. .

„ 7. Clean red gravel, corresponding with Bed No. 5 in Fig. 1, forming floor of reservoir . .

[2] This gravel (No. 5), which forms the floor of the reservoir, is of very considerable thickness. At one spot, where pumping for "puddling" had been going on, a hole more than ten feet in depth from the surface of the gravel-bed still showed the same gravel with abundance of water.

Fig. 3.—Section in the Eastern Reservoir, and near the Embankment between the Eastern and Western Reservoirs:—

Bed No. 1. Surface soil, 18 inches . . . 1

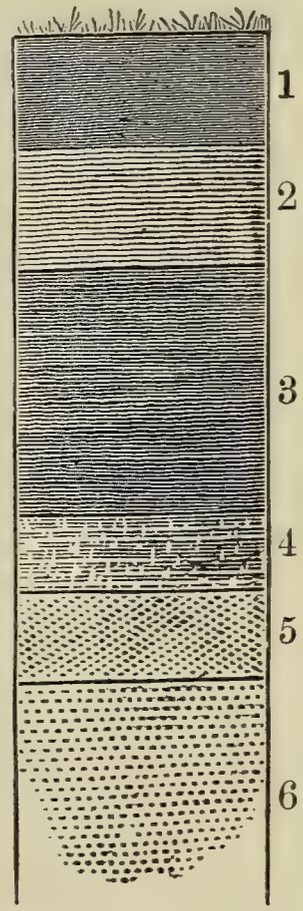
,, 2. Stiff clayey loam, 18 inches . . 2

,, 3. Very compact black peat, 3 feet . 3

,, 4. Shell-marl, 12 inches 4

,, 5. White-coated subangular gravel, 12 inches 5

,, 6. Clean red gravel, forming floor of reservoir, and equivalent to Bed No. 5 in Fig. 1, and to Bed No. 7 in Fig. 2 6



The beds above the shell-marl, and in some parts of the area those below it also, contained abundant remains of old forest vegetation; large areas of the upper loamy and peaty beds, where exposed in the course of the works by the removal of the more superficial layers, exhibiting the ancient remains of trees with their spreading roots still *in situ*, but in most instances converted into lignite and coated with bog-iron ore. Hazel-nuts were also abundant, and one could easily detect evidences of the presence of the oak and the alder. Other trees were probably present, and could no doubt have been determined by a microscopic examination of their wood. The peat, especially in Section No. 3, was exceedingly stiff and compact.

The shell-bed on the Eastern and Northern sides of the area exposed, exhibited many instances of oblique lamination, indicative of currents and a winding river-course. Most of the bivalve shells had their valves united, the *Uniones* reposing in their natural position as in life; whilst the operecula remained in the apertures of many of the *Paludinæ*.

The following is a list of the land and fresh-water shells which were obtained by me from the shell-marl at the Reservoirs of the East London Water-works Company, Walthamstow Marshes, Essex:—

Helix hortensis, Müller.
,, *nemoralis*, Linn.
,, *arbustorum*, Linn.
,, *ericetorum*, Müll.
,, *caperata*, Montf.
,, *hispida*, Linn.
Succinea putris, Linn.
Zua lubrica, Müll.
Clausilia bidens, Müll.
Limnea stagnalis, Linn.
,, *peregra*, Müll., sp.
,, *auricularia*, Linn., sp.
,, *palustris*, Linn., sp.
Limnea truncatula, Müll., sp.
Planorbis corneus, Linn., sp.
,, *carinatus*, Müll., sp.
,, *vortex*, Linn., sp.
Ancylus fluviatilis, Müll., sp.
Valvata piscinalis, Müll.
Bithinia tentaculata, Linn.
,, *ventricosa*, Gray.
Neritina fluviatilis, Linn.
Unio tumidus, Retz.
,, *pictorum*, Linn.
Pisidium amnicum, Müll.
Cyclas cornea, Linn.

Besides the Mollusca, the peat and shell-marl together yielded many evidences of man and his works. There were numerous skulls and portions of skeletons of both historic and prehistoric Britons, and remains of weapons showing the same variety of date. There were also found bronze spears and arrow-heads, a bronze knife, a bronze handle of a late Celtic dagger, and various examples of late Celtic earthen pots (some hand-made, and some turned with a wheel); and lastly, a flint scraper which I extracted myself from an undisturbed bed of dark loamy clay, three feet below the surface.

List of Mammalian and other remains obtained from the peat and shell-marl at the Reservoirs of the East London Water-works Company, Walthamstow Marshes, Essex (1869):—

MAMMALIA.

Man.—By his osseous remains, and implements in stone, bone, bronze, and iron.
Canis lupus, Linn. The Wolf.—Common.
Vulpes vulgaris, Briss. Fox.—Not common.
Castor europæus, Owen. Beaver.—Several examples.
Equus caballus, Linn. Horse.—Abundant.
Sus scrofa-ferox, Linn. Wild Boar.—Abundant.

Cervus elaphus, Linn. Red Deer.—Abundant, of all ages.[3]
,, *capreolus*, Linn. Roebuck.—Not common.
,, *dama*, Linn. Fallow Deer.—One antler (probably recent).
,, *tarandus*, Linn. Reindeer.—Antlers, rare.
Alces palmatus (*C. alces*), Linn. Elk.—Rare.
Capra hircus, Linn. Goat.—Abundant, many skulls of kids.
Bos primigenius, Boj. Gigantic Ox.—Not common.
,, *longifrons*, Owen. Small Ox.—Common.
,, *frontosus ?* Nilss.—Rare.

AVES.

Haliætus pelagicus. Sea Eagle.—(Tibia) Rare.
Sp. ?—A few bones.

PISCES.

Sp. ?—(Vertebræ, &c.) Rare.

From the lower beds reached in excavating for the "puddle-wall" were obtained:—

Elephas primigenius, Blum.—Portions of tusk and molar tooth.
Bos primigenius, Bojanus.—Head and horn cores.
Cervus strongyloceros, Owen.—Base of a gigantic antler.

The most interesting of the animal-remains from these later deposits are:—The Roebuck (*Cervus capreolus*), the Wild Boar (*Sus scrofa-ferox*), the Wolf (*Canis lupus*), the Gigantic Ox (*Bos primigenius*), the Elk (*Alces palmatus*), the Reindeer (*Cervus tarandus*), and the Beaver (*Castor europæus*).

The Roebuck is now confined to Scotland, but it was formerly as widely distributed as the Red Deer through our English Forests.

The Wild Boar[4] is now exterminated in this country; but, judging by its remains, it was once most abundant in the forests of Essex.

The Wolf[5] has also been entirely killed out in this country. Its remains prove that it was very abundant in Walthamstow Forest.

[3] The antlers and tynes of the Red Deer were in many instances *cut* previously to their having been imbedded.

[4] See Harting's 'Extinct British Animals,' 8vo, 1880, pp. 77—114.

[5] *Op. cit.*, pp. 115—205.

The Gigantic Ox (*Bos primigenius*) is quite extinct as a species. The Reindeer and the Elk, though killed off in this country, still survive in Norway, Siberia, and in North America.

The Beaver, once common in many parts of England, Scotland, and Wales, as is proved by its fossil remains in our peat deposits, has also given its name to many places, as "Beverley," in Yorkshire; "*Llyn-yr-afange*," or the Beaver's Lake; "*Nant-yr-afancwm*," or the Vale of the Beavers; &c. It was very abundant at Walthamstow, and elsewhere in Essex and Cambridgeshire.[6]

The only European Beavers now met with are said to inhabit the lowlands near the mouths of the Danube and Volga; and in some of the rivers which take their rise in the Ural Mountains. Its antiquity is proved not only by its wide geographical range through Europe and North America,—as far as Vancouver's Island; but also from the fact that both in America and in this country it was represented at an earlier period by a gigantic predecessor, the *Trogontherium cuvieri* from the Norfolk Forest Bed, and the *Castoroides ohioticus* from Ohio, U.S.A.

I should like to say a few words with regard to the Beaver. The Beaver was found in considerable numbers at Walthamstow, and equally so through the Fen-land of Cambridge, at Copford in Essex, and in fact all through our Eastern counties. There can be no doubt, I think, from an examination of the peat-deposit and the large quantity of trees not connected with stumps, that the Beaver must have lived here for a very long time; and wherever the Beaver lived, there it is sure to have constructed dams. I believe that the Beaver had been in this district, as he is now in America, an important geological agent. His work, while producing enjoyment to himself, is eminently destructive to the district which he

[6] Some account of the European Beaver will be found in Owen's 'British Fossil Mammals and Birds,' 8vo, 1846, pp. 190—200; and Harting's 'Extinct British Animals,' 8vo, 1880, pp. 33—60. The *Trogontherium* is described by Owen, Brit. Foss. Mamm., pp. 185—189; and Geol. Mag., 1869, vol. vi., pp. 49—56. See also Dr. H. Woodward, Geol. Mag., 1869, vol. vi., pp. 69 and 388.

occupies. Every stream is converted by the Beavers into a series of falls with beaver-dams, and large, deep, clear, still pools of water. It is evident that, if ever a big flood came down such rivers, these beaver-dams would be quite calculated to cause an overflow and an inundation of the Forest for miles around. Many of the forest-trees could not stand this excessive damp, and would give way to *Sphagnum* or bog-moss; and large tracts thus flooded would be converted into peaty, marshy fen-land. That I believe to be the origin of the fen-lands over a great part of our Eastern counties. Of course, geologically, there is another aspect of the question which we must not omit to mention; that is, the strata in this area are of a soft clayey, chalky, or sandy character, and lend themselves admirably to the action of denuding agents: but I have no doubt that the Beaver helped these agents most effectively. By damming back the water of its streams it destroyed the Forest, and converted it by degrees into a primitive marsh.[7]

We must now pass from the consideration of the series of deposits characterised by the fauna nearest to that existing at the present day to those belonging to an earlier date, but which are also found in the valleys of the Thames, the Lea, and the Roding, and which underlie the more superficial deposits of which we have already spoken. They consist mainly of gravels, sands, and brick-earth, and are all of fluviatile origin, being marked by the presence of land and

[7] "The flow of streams is sometimes interfered with, or even diverted by the operations of animals. Thus the Beaver, by cutting down trees (sometimes one foot or more in diameter) and constructing dams with the stems and branches, checks the flow of water-courses, intercepts floating materials, and sometimes even diverts the water into new channels. This action is typically displayed in Canada and in the Rocky Mountain regions of the United States. Thousands of acres in many valleys have been converted into lakes, which, intercepting the sediment carried down by the streams, and being likewise invaded by marshy vegetation, have subsequently become morass, and finally meadow-land. The extent to which, in these regions, the alluvial formations of valleys have been modified and extended by the operations of the Beaver is almost incredible" (Geikie's 'Geology,' p. 455). See also 'The American Beaver and his Works,' by Lewis H. Morgan, Philadelphia, 1868.

fresh-water Mollusca, and the bones of land animals. These deposits are well seen at Ilford, and similar deposits are found at Crayford, Erith, and Grays. In these older deposits it will be seen that the Thames Valley gravel overlies the yellow sand and brick-earth. The age of these yellow sands and clayey brick-earths is very well marked, for they everywhere contain that most characteristic bivalve shell—*Cyrena fluminalis*.[8] It is excessively interesting to note that this little mollusk is now known only as an inhabitant of the River Nile, so that its distribution was once very much wider over Europe than at present. It no doubt indicates a great

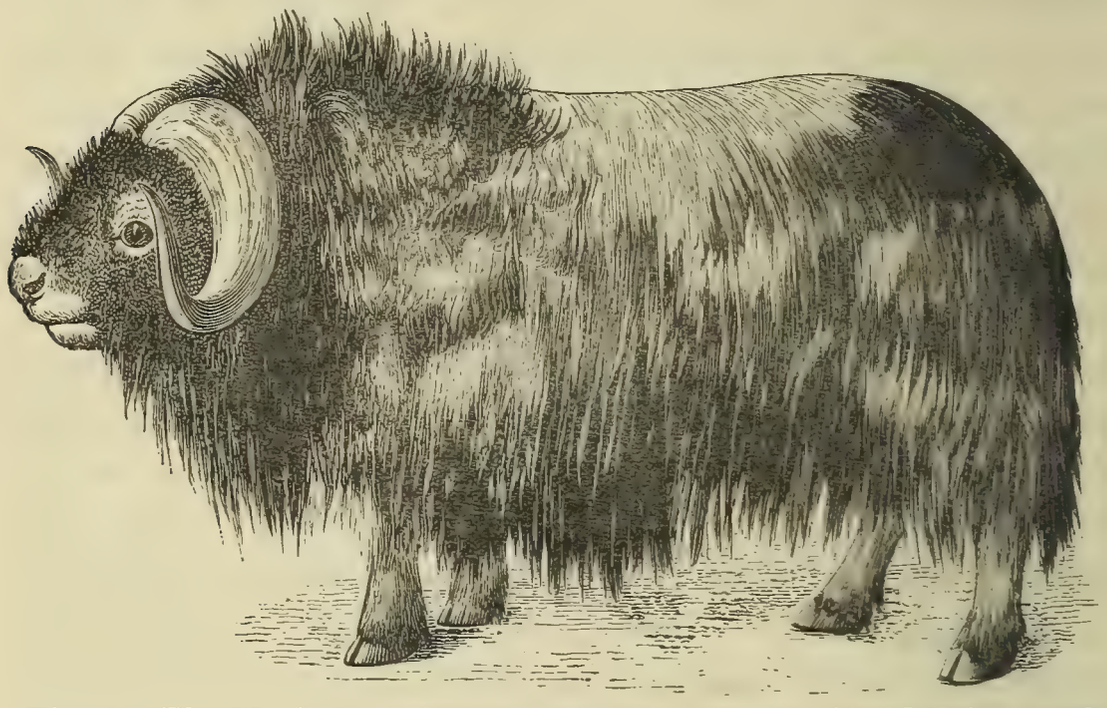


Fig. 4.—The Musk-Ox (*Ovibos moschatus*), now only found living on the treeless barrens of Arctic America and Asia. It was shot on North Grinnell Land during the last Arctic voyage of the 'Alert' and 'Discovery.' Its remains have been found at Maidenhead; at Green Street Green, in Kent; at Crayford; and Grays. [Reproduced, by permission, from the Guide Book to the Geological Department in the British Museum of Natural History.]

geological and climatic change, and most certainly marks the lapse of a long period of time. In the brick-earth we become acquainted with a land-fauna of which only a stray form or two now exist. Thanks to the researches of Sir Antonio Brady and others, we are able to record from these brick-

[8] *Cyrena consobrina*, Caill. Voy. Egypt, 2, t. 61, fig. 10, 11. Morris, Cat. Brit. Foss., 1854, p. 199.—Grays, Ilford, Erith.

earths the remains of the Lion, the Bear, the Mammoth, the Straight-tusked Elephant, the Small-nosed Rhinoceros, the fossil Horse, the Gigantic Irish Deer, the Bison, the Reindeer, the Musk-Ox (fig. 4), theElk, the Marmot, the Fox, and the Red Deer; and to this list might be added from other localities of similar age, the Hyæna, the Sabre-toothed Tiger, the Antelope, the Glutton, the Gigantic Beaver, the Southern Elephant, and Sedgwick's Deer—a very large Deer with branching antlers, which, with the Gigantic Beaver and *Elephas meridionalis*, occur in the Norfolk forest-bed. If we divide these animals into groups, we shall find first a series from the South, such as the Sabre-toothed Tiger, the Cave Lion, the Hyæna, the Straight-tusked Elephant, the Southern Elephant, the *Rhinoceros leptorhinus*, *Rhinoceros megarhinus*, and the Hippopotamus. Then there are a number of Eastern forms, such as the Lynx, the Mammoth, the Woolly Rhinoceros, the Gigantic Ox, the Bison—which now remains preserved by the Emperor of Russia in Lithuania—and the Brown Bear; for my colleague, Mr. Wm. Davies, F.G.S., informs me that a subsequent examination of these remains of the Bear from Ilford proved them to belong to the Brown Bear, *Ursus ferox*, and not the old species, *Ursus spelæus*. Then we have a number of extreme Northern forms associated in this same series of brick-earths, such as the Musk Ox, the Reindeer, the Elk, the Marmot, the Lemming, the *Lagomys*, and the Glutton. The Pouched Marmot, *Spermophilus*, occurs in the Thames Valley. The Lemming and the Tailless Hare have not yet been found here, but in the valley of the Avon; the Glutton, another Arctic form, has been found in the caves of Banwell, Bleadon, and Gower. The Sabre-toothed Tiger[9] does not occur in Essex, but it has been found in Norfolk associated with the Gigantic Beaver. Then, in addition to those animals which have come from the South, the East, and the North, there are certain forms—the

[9] The range of the *Machairodus* or Sabre-toothed Tiger is truly remarkable. Its remains have been obtained from South America; from British and French caves; from Epplesheim; from the Val d'Arno, Italy; and from the Sewalik Hills, in India (see fig. 7, p. 15).

Gigantic Beaver, the Gigantic Irish Deer (fig. 5), Sedgwick's Deer, the Red Deer (still living), the Horse, and the Fox.

It would be interesting if we could by any possibility picture to ourselves the conditions of life, and the conditions of

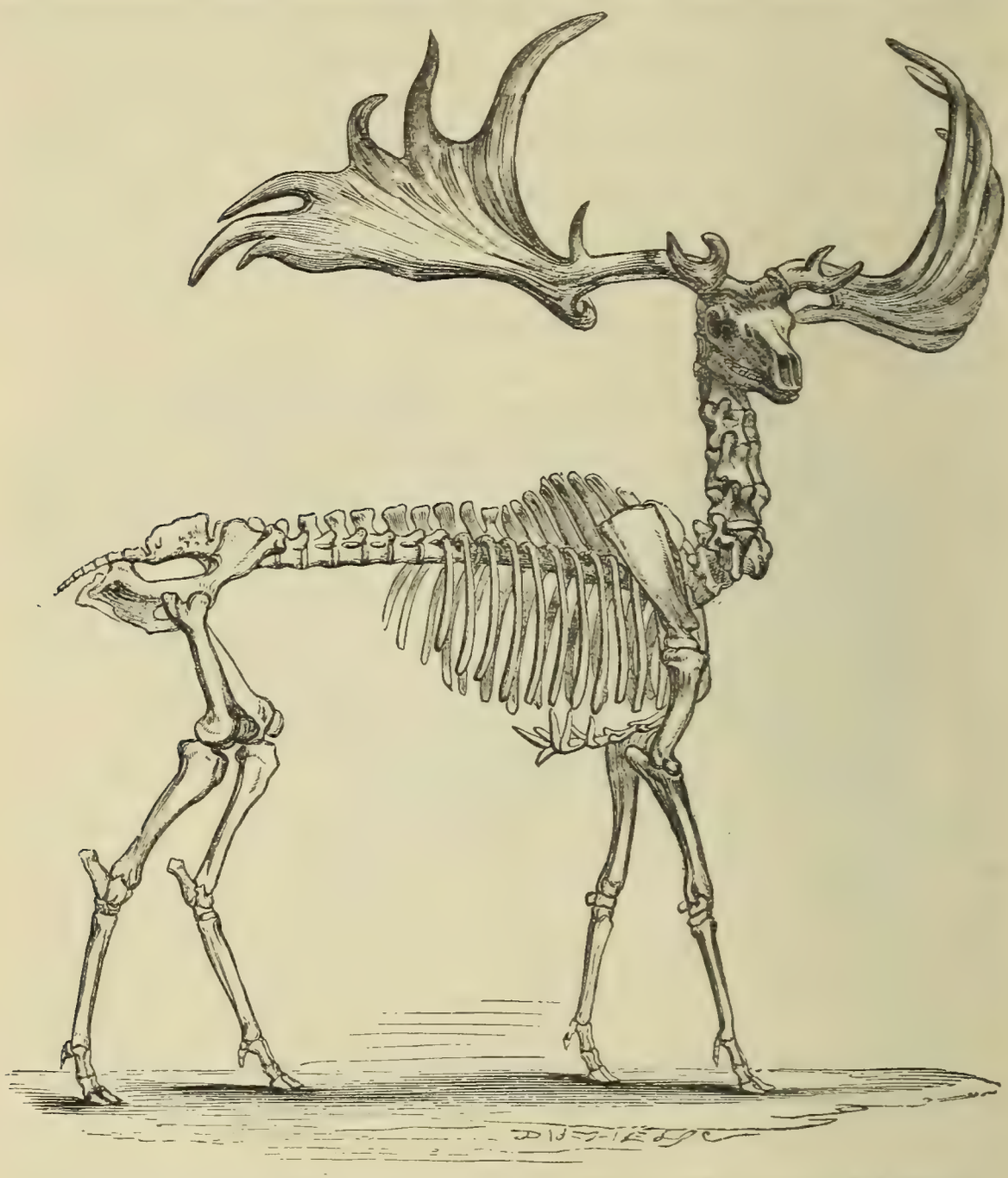


Fig. 5.—Skeleton of Gigantic Irish Deer *Cervus* (*Megaceros*) *hibernicus*, Owen. Met with in the shell-marls and clays beneath the peat-bogs in Ireland. [Reproduced, by the courtesy of Messrs. A. and C. Black, from Prof. Owen's 'Palæontology,' p. 405.]

climate in Britain under which animals of such varied characters lived, the remains of which are met with in a single series of deposits such as the Thames Valley affords! We cannot avoid the conclusion that a very great change must have

taken place in the physical as well as the climatic conditions of this country to enable animals of such varied habits, many of whom possess strong migratory instincts, to have inhabited our Island. It seems absolutely necessary that we must carry back the period at which these animals lived, to a time when our Island was not separated from the Continent, as it now is, but when the North Sea and the Straits of Dover were all closed and formed one solid stretch of land, passing from the Humber across to Heligoland and the coast of Denmark, and also from Norfolk to Holland and from Dover to France. Then again, the southern portions of our island must have been connected with Brittany. It would only require an elevation of six hundred feet to connect England with Ireland,—and someone has said that it would be a very happy event if we were so connected with Ireland now, because then the people could not clamour, as they are doing, for separation. The Rhine, the Meuse, and Moselle must have, at that time, all flowed northward. But what is most interesting is, that there are certain banks very well known to the fisherman, where good dredging is done, and good trawling,—particularly the one known as the "Dogger Bank,"—which have yielded, from the beginning of this century up to the present time probably many thousand remains of the true Mammoth, *Elephas primigenius* (fig. 6), the one which in past times spread over the whole of Northern Europe, and whose remains have been found so abundantly in the frozen mud-cliffs described by Kotzebue; and also along the Lena, the Yenisei, and all the Northern rivers which have their embouchure into the Arctic Sea. The remains of these animals are no doubt spread out over a vast extent of the floor of what is now the North Sea, and the fishermen were in the habit of bringing to Yarmouth, together with the fish, the remains of the Mammoth which they had dredged up.[10] Mr. J. J. Owles,

[10] Mr. Samuel Woodward (Author of the 'Geology of Norfolk,' and father of the writer) records that no fewer than 2000 Elephant-grinders had been dredged up from the Oyster-bed off Happisburgh, Norfolk, by the fishermen between 1820 and 1833. See also Falconer's 'Palæontological Memoirs'; 1868, vol. ii., p. 204.

of Yarmouth, has paid great attention to this subject, and has made a very large collection, which is now in the south-east gallery of this Museum; forming a most striking series of the remains of the Mammoth, comprising an enormous number of tusks as well as molar-teeth.[11] Many of the tusks are of great

Fig. 6.—Lower Jaw of Mammoth (*Elephas primigenius*) dredged off the Dogger Bank, in the North Sea, 1837. (See Geol. Mag. 1878. Decade II. vol. v., pl. xii., p. 443). The original is preserved in the British Museum (see Pier-case 16). [Reproduced, by permission, from the Guide to the Geological Gallery of the British Museum.]

length and singular curvature; they all exhibit a double twist, and this is the characteristic of all the specimens of the Mammoth-tusks found in Siberia. This mausoleum of the Mammoth is also rich in remains of the Reindeer, the Gigantic Ox, and other animals; and all along the coast have been found abundant evidences of *Elephas meridionalis*, the

[11] See an interesting paper on the Pleistocene Mammals dredged off the Eastern Coast, by Wm. Davies, F.G.S. Geol. Mag. 1878. Decade II., vol. v., p. 97.

Woolly Rhinoceros, the Big-nosed Rhinoceros, the Gigantic Beaver, and many other of the animals already mentioned, including the Sabre-toothed Tiger, which has also been found at Kent's Cave, Torquay; so that we have evidence in two places at least of its occurrence. An elevation of six hundred feet would change not only the physical conditions of our island, but also its climate. Instead of that variable mildness which now characterises our winter season, we should have then a more Continental climate, more severe cold would be experienced in winter, and also a greater heat in summer. Then, too, it must be remembered that our highlands would be standing at a greater elevation. Our Scotch mountains, instead of every year shedding their mantle of snow, would at that period have retained snow all the year round; the Welsh mountains would also have been deeply immersed in snow, and probably have remained covered during the whole year. The great valley of the North Sea at that time would have formed a grand grazing ground for the herds of Elephants, Reindeer, Wild Horses, and other large herbivores; whilst the Sabre-toothed Tiger, the Lion, the Bear, the Hyæna, and Wolf, would have had ample opportunity for following their calling in the same area. My colleague, Mr. William Davies, has made an interesting suggestion as to the cause of the paucity of the remains of the Carnivora in these deposits. We seldom find remains of these carnivores: we meet with a fragment here and a fragment there, but they bear no proportion to those of the herbivores. The explanation

Fig. 7.—Skull of the Great Sabre-toothed Tiger (*Machairodus*), from the Newer Tertiary deposits of South America. [Reproduced, by permission, from the Guide to the Department of Geology in the British Museum.]

seems to be this: these animals were not only more active, but the majority of them were nocturnal in their habits; and no doubt when the Herbivora were overtaken by floods it was frequently in the night when they were asleep—just the time when the Tigers, Lions, Bears, and Wolves would be wide awake; and they would probably get up the nearest tree or escape to the higher ground, or some other suitable place, and so avoid the catastrophe. And, indeed, many of them must have escaped, or we should have a far larger proportion of their remains; though it must always be borne in mind that one pair of Lions or one pair of Bears occupied a very large tract of country; and therefore we should not expect them to be in such numerical abundance as the Herbivora on which they fed.

It may be interesting to inquire how it happens that the remains of both northern and southern forms are found commingled together in these deposits. When those immense herds of Mammoths occupied the North Sea Valley and the adjacent countries, it seems probable that the conditions of climate in the extreme North of Europe and Asia had previously become unbearable for them, and they had been driven south. At any rate, if they did not remain all the year, they migrated south every winter. All the Arctic species would come down into this country for the winter, and stay here until the summer invited such animals as the Reindeer, the Elk, and the Musk-Ox to migrate northward in great herds, as they do at the present day on the Continent, towards the feeding grounds, which in winter are uncongenial to them, but in summer afford them rich pasturage. In the same way, in the summer season, the Rhinoceros, the Hippopotamus, and other more southern animals, with great herds of Wild Horses, would no doubt advance northwards and westwards with the change of season. Such climatal and physical conditions enable us to explain that curious admixture of animal-remains found in these deposits, which otherwise would not be so easy to comprehend. We are moreover confirmed in this view by the fact that we find the same state

of things in Central France. There the old cave-folk lived, apparently, upon the Horse and the Reindeer equally, for from their remains it is quite evident they must have hunted them season and season about. It is interesting to notice that the remains of these animals are spread over all the metropolitan area, even beneath the ground upon which the New Natural History Museum is built. Beneath us is the old river-valley gravel of the Thames, and in it were found remains of the Mammoth and the Ox. In Gray's Inn Lane the skeleton of a Mammoth and a palæolithic flint implement were

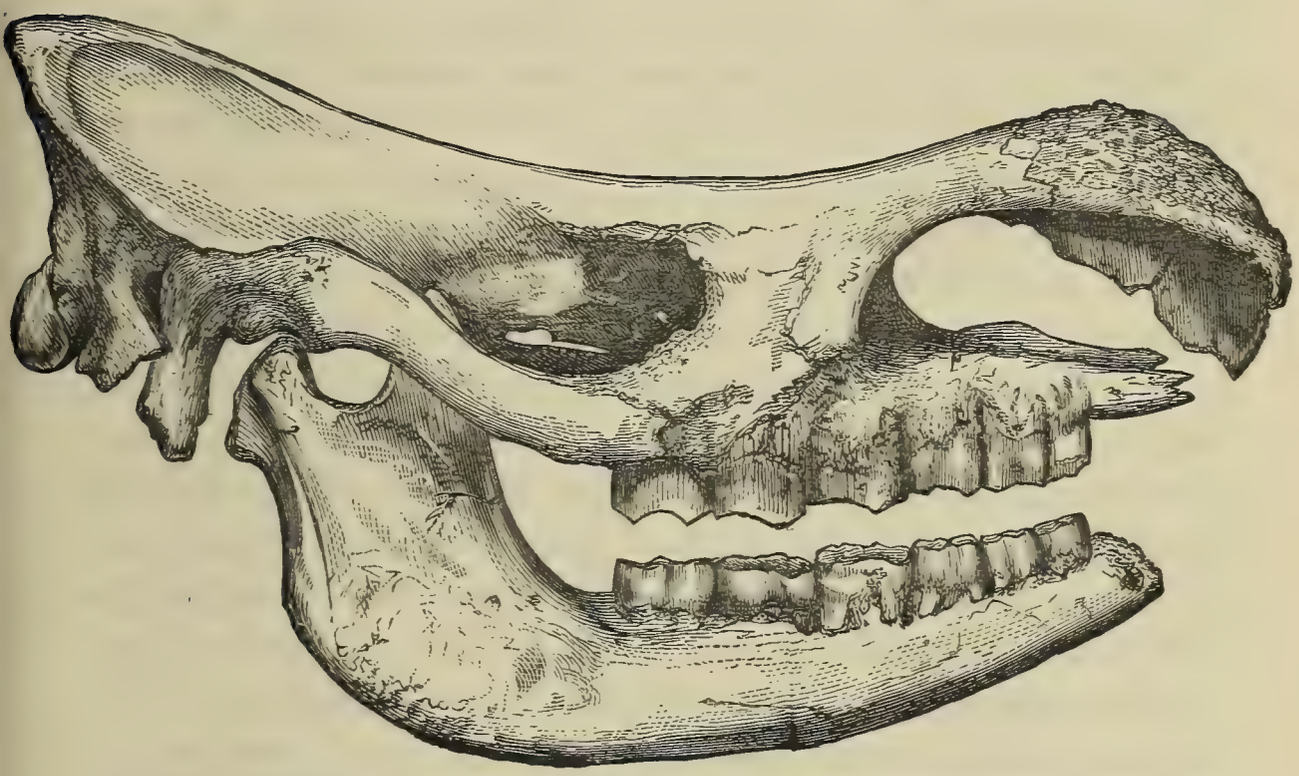


Fig. 8.—Skull and lower jaw of *Rhinoceros leptorhinus*, Owen, from the Pleistocene Brick-earth of the Thames Valley, at Ilford, Essex. The original, from the collection of the late Sir Antonio Brady, F.G.S., is now in the British Museum. See Geol. Mag. 1874. Decade II., vol. i., p. 398, pl. xv. [This woodcut is obligingly lent by Messrs. Cassell & Co., from their 'Natural History,' vol. ii., p. 334.]

found associated together. In Piccadilly, close to where Burlington House stands, the remains of Hippopotamus were found; and also at Peckham and at Woolwich, and all along the Thames, their remains are more or less abundant. In the Museum there is a very perfect skull of *Rhinoceros leptorhinus*, found at Ilford (fig. 8). Three species of *Rhinoceros* occur in these old brick-earths, the Woolly Rhinoceros which belonged to the northern fauna came south,

meeting here with the *Rhinoceros leptorhinus* and *megarhinus*. Still further back in time, it seems as if there must have been a still colder period, marked by glacial deposits on the top of the high grounds forming the divisions between the Thames, the Roding, and the Lea, and also on such high grounds as at Muswell Hill. Then after this period, which must have been one of submergence as well as of cold, we had no doubt a cold period of emergence, when the land stood higher than at present. That gradually passed away and was succeeded by a somewhat warmer period, marked by a corresponding change in the fauna of the valley, and the predominance of more southern forms; and that must have extended up to those Norfolk beds which have yielded a large number of southern forms. Then we reach the Norwich Crag with a fauna characteristic of a period of depression, and then a warmer period, marked by the Red and Coralline Crags of Suffolk. Lastly an Eocene Period, with its subtropical fauna and flora.

Mr. Gardner has mentioned to me that he has found what appears to him to be evidence of a truly Arctic flora in the Reading plant-beds; so that just at the close of the Eocene Period, and at the top of the Chalk, there was probably an intervening cold land period. But there does not appear to have been any cold period again till we reach the Post-Tertiary deposits. These oscillations of climate have no doubt recurred again and again during long stretches of time, but with vast intervals between. We must not suppose for a moment that the land has risen and fallen like the mercury in a barometer. These processes of elevation and subsidence have been very slow, and have occupied inconceivably long periods of time; and when one is asked to believe in repeated glacial periods marked by only a few feet thickness of strata, one ought to be very careful in receiving such doctrines. I do not believe that any sound geologist who has carefully considered what is involved in any great change of climate can ever entertain such an idea. It takes a very, very long period of centuries or thousands of years to bring about any considerable climatal change. We can easily imagine a local change taking place;

but it would be only local; considerable changes of level, for instance, have taken place in our own Thames Valley. Below high-water-mark, in the neighbourhood of Victoria and Albert Docks at Plaistow, there are abundant evidences of deposits such as I have spoken of, and a canoe has been found, showing that primitive man was there when the valley stood at a far higher level than now. Mr. Searles Wood in some of his papers mentions trees *in situ* at many points below the present level of the Thames, affording good evidence that in prehistoric times the level of the Thames stood considerably higher than it does now; and that savage men, if not civilised men, at that time occupied the country.

Probably no independent geological investigator since the early days of Buckland, Trimmer, and Morris, has paid such careful attention to the structure of the Thames Valley, and of its contained deposits, as Mr. Searles V. Wood, F.G.S. Numerous papers on this subject have been communicated by him to the 'Quarterly Journal of the Geological Society' and to the 'Geological Magazine.'

Writing thereon in 1866 (Geol. Mag., vol. iii., p. 59), Mr. Wood observes: "The brick-earth of Ilford, both that of Uphall and that of the London-road Field, is a deposit *underlying* the Thames gravel, and unconformable to it." He also speaks of it as *anterior* in date to the similar deposit of Grays, which likewise contained *Cyrena fluminalis* and other purely fresh-water shells.

In a letter to me (dated March 10, 1874) Mr. Wood says:—

"When I wrote the paper in vol. iii. of the Geol. Mag. (1866), I was under the impression that, though the Grays brick-earth was clearly newer than the main sheet of the Thames gravel (it forming distinctly a terrace beneath it), the *Cyrena* brick-earth of Ilford, and of Crayford and Erith, was anterior to, and passed underneath, it. Some year or two afterwards, however, I satisfied myself that this was an error as concerned Crayford and Erith, and I wrote a letter to the 'Geological Magazine' (Oct. 10, 1868, vol. vi., p. 534) directly, to acknowledge this.

"The Ilford bed lying flush with the gravel sheet of that part of Essex does not present the means of determination by section; but I cannot doubt, however, that it is identical

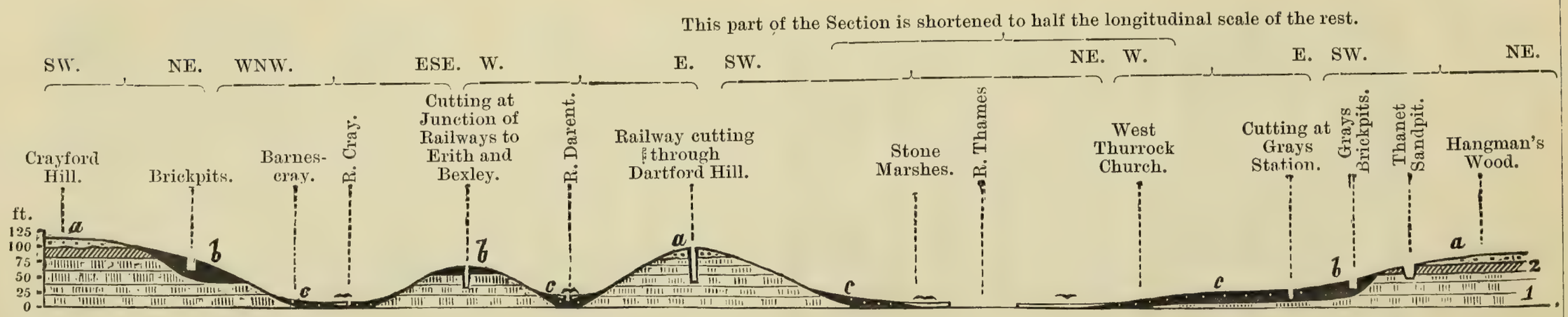


Fig. 9.—Section from Crayford to Hangman's Wood. Length: Nine Miles along an Irregular Line. Prepared by Mr. S. V. Wood, F.G.S.

[Reproduced from Sir Antonio Brady's Catalogue of the Ilford Mammalia, 1874.]

1. The Chalk. 2. The Thanet Sand.

a. Thames Gravel of the Highest Elevation and which covers Dartford Heath.
b. *Cyrena* Brick-earth.
} Formed when the Sea occupied the Weald, and the Drainage from the Thames area passed into it.

c. Gravel (with some Brick-earth) formed since Drainage acquired its present direction.

— Recent Alluvium.

N.B.—The *Cyrena* Brick-earth at both Grays and Crayford is partially underlain by Gravel.

Key to Geological Map of Ilford.
(See opposite page.)

- Alluvium.
- Brick-earth.
- Gravel.
- London-clay.
- Woolwich and Thanet Beds.
- Chalk.
- Roads.
- Railways.

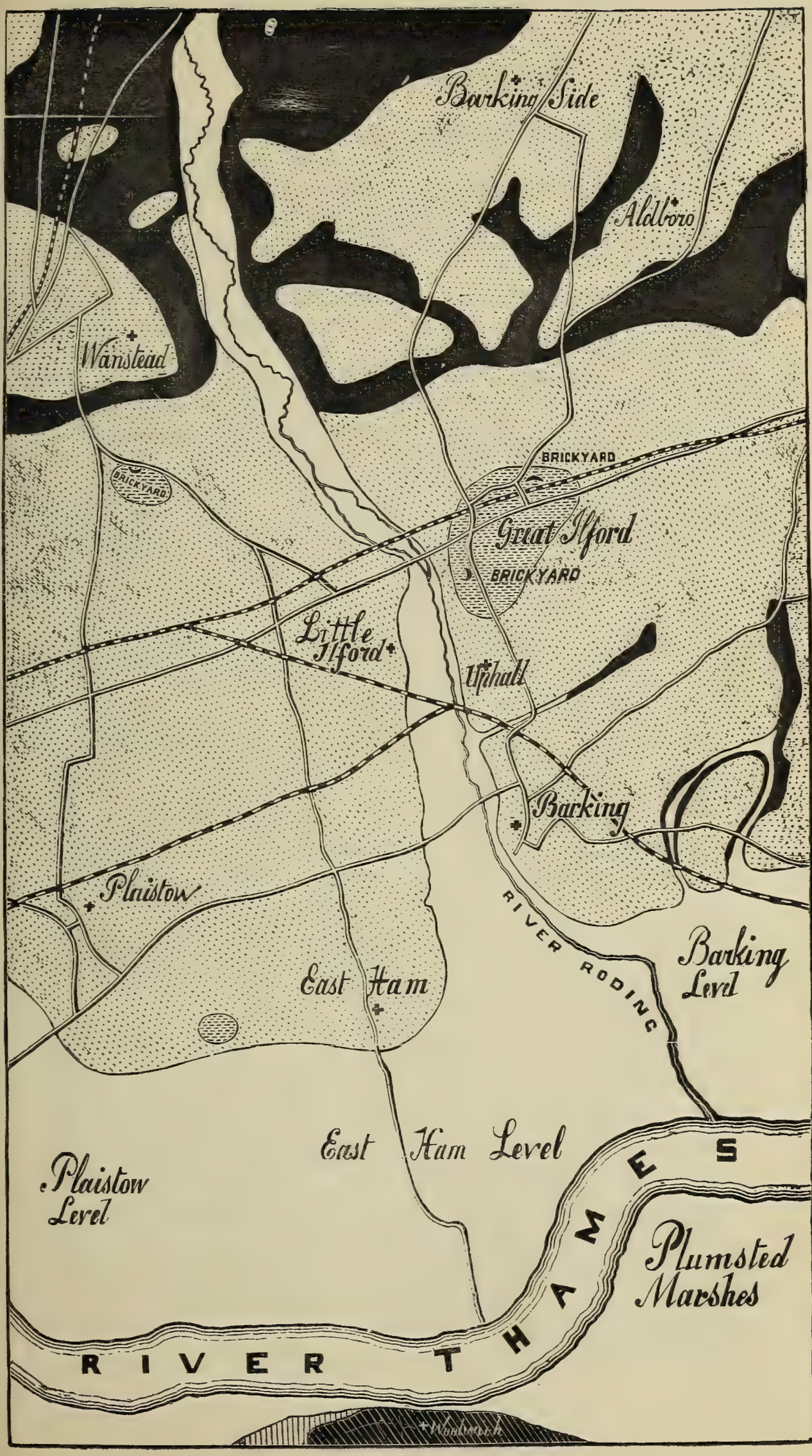


Fig. 10.—Geological Map of the district around Ilford, whence the great collection of Pleistocene Mammalian remains forming the "Brady Collection" (now in the British Museum of Natural History) was obtained.

in age with the *Cyrena*-beds of Grays, Erith, and Crayford.

"Such being the case, so much of the Section No. 3, given at p. 61 of the 'Geological Magazine,' 1866, vol. iii., as shows this brick-earth (x 4′) underlying the gravel (x 4″), is incorrect. . . . . .

"The subject, however, is obscure; and while the brick-earth at Ilford, Grays, and Erith lies low, and forms a lower terrace to the main sheet of the Thames gravel, it rises at Crayford to a greater elevation, nearly eighty or ninety feet in parts, and forms a high terrace above the gravel of the Cray and Darent Valleys, but below the main gravel sheet which forms Dartford Heath (see bed *b* of Section, fig. 9).

"This anomaly and seeming contradiction is due in my view to the reversal of the drainage during the progress of the formation of the Thames Valley and the denudation of the Weald, as discussed by me in my paper in the Quart. Journ. Geol. Soc., 1871, vol. xxviii., p. 3."

In order to make the foregoing view more intelligible, Mr. S. V. Wood has most obligingly prepared the accompanying Section[12] (fig. 9), and adds:—

"Crayford is nearer to the region of Wealden elevation than the other localities of the *Cyrena* brick-earth; and this brick-earth has there been so elevated that the gravel of the Cray and Darent Valleys (*c* of fig. 9) forms in places a very distinct deposit occupying the valley-bottoms, and lying at a level considerably below that of the *Cyrena* brick-earth. This gravel *c* is, in my view, a deposit formed since the drainage was reversed into its present direction; the *Cyrena* brick-earth, on the other hand, having been deposited while the drainage from the Thames Valley flowed into the sea which covered the Weald. (See Section).

"I should, however, point out, as one of the perplexing features of this obscure subject, that if we follow the gravel *c* from the Cray and Darent Valleys to the edge of the Stone Marshes, and crossing the Thames pursue it from its re-appearance above the West Thurrock Marshes to the edge of

[12] Fig. 9 is reproduced from Sir Antonio Brady's 'Catalogue of the Pleistocene Vertebrata from the Neighbourhood of Ilford, Essex,' London, 1874. For other sections prepared by Mr. S. V. Wood to illustrate the Geology of this area, see "A Day's Elephant Hunting in Essex," by Mr. Henry Walker, F.G.S., with folding plate of lithographed sections, and two woodcut sections on p. 32, Trans. Essex Field Club, vol. i., pp. 27—58 (September, 1880).

the *Cyrena* brick-earth at Grays, it seems to inosculate with the gravel which (as shown in the Section at page 62 of the third volume of the 'Geological Magazine'; and Trans. Essex Field Club, vol. i., p. 32) partially underlies the brick-earth at that place. I, however, believe that this inosculation is not real, but that the gravel, *c*, really lies up against the beds of gravel, sand, and brick-earth which form the *Cyrena*-deposit of that place, and which are shown in the present Section under the letter *b*. All the gravel and brick-earth beds occurring in the valleys of the Thames, and of its tributaries, are now pretty generally admitted by geologists to be posterior to the true Glacial period; and their relation to the extensive deposit of Glacial clay which covers so much of the midland and eastern counties (Bed No. 6) is shown by Section on page 32, Trans. Essex Field Club, vol. i. (reprinted from page 43 of the fifth volume of the 'Geological Magazine,' 1868)."

"To return to the Ilford brick-fields: the *Cyrena* brick-earth here attains a thickness of nearly twenty feet. It may be seen in the field on the London-road resting in one part direct on the London-clay, while in another part it has a thin band of shingly gravel beneath it. In the Uphall brick-field its position relatively to the newest gravel is best shown, the two deposits being unconformable.

"When we consider the limited area from which the collection of the late Sir Antonio Brady has been made, it seems not a little remarkable that it should so well represent the vertebrate fauna characteristic of these deposits, in regard to the number of species; whilst it greatly exceeds in number of specimens any hitherto attempted from this neighbourhood. The relative proportions of the remains of the several families are also such as are generally found in similar deposits in other localities.

"Of the Carnivores the remains are few,—only eleven,—and belong to the Lion, Fox? (one fragment), and the Bear. The first is represented by two examples; but, as we might expect from the known active habits of the Felidæ, their remains are comparatively rare in all aqueous deposits, being more generally found in caves and rock-fissures. Of the Bear one species is recorded as having been found at Ilford, viz., *Ursus ferox*.

"The remains of the Proboscidæ are numerous, and are referable to two species—*Elephas primigenius* and *E. antiquus*. This group is not only numerous in specimens (about three hundred), but also in individuals, of which there are the remains of eighty-four, as indicated by jaws and teeth alone, exclusive of the tusks; of these there are fourteen examples, large and small. Even assuming that many of the limb and other bones might have belonged to one or the other of these individuals, we may still fairly estimate that there are portions of more than one hundred Elephants in the collection; for there are few instances in which more than one bone could be assigned to the same animal. Of the greater portion of the bones of the skeleton there are many fine examples, and they illustrate, together with the teeth and jaws, individuals of every age and size—from the smallest sucking-calf to the animal of most mature age.

"The Pachyderms are represented by three genera, viz., *Rhinoceros*, *Equus*, and *Hippopotamus;* and collectively comprise 121 specimens. Of the *Rhinoceros*, remains of three species are present—*R. leptorhinus*, *R. megarhinus*, and *R. tichorhinus*, those of the first being the most numerous. Of this species there are seventy-seven separate remains, consisting of skulls, jaws, detached teeth, vertebræ, and limb-bones. The Megarhine Rhinoceros, of which there are seven examples, is comparatively rare at Ilford; whilst at Grays, a few miles off, it is the species most frequently found. The Tichorhine Rhinoceros is also rare in this locality, being only represented in the collection by two fragments. The same remark applies to the two species of Elephants occurring in these deposits; for whereas the Mammoth (*Elephas primigenius*) is the common species at Ilford, and *E. antiquus* the less prevalent form, the Grays deposit, on the contrary, yields a larger number of the latter species, whilst the former is there more seldom met with. Of the remains of the Horse there are thirty-four specimens, including a fine fragment of the skull. The Hippopotamus is only represented by a single fragment—the body of a lumbar vertebra.

"The Ruminant remains constitute fully one-half of the

collection, numbering more than 500 specimens, consisting of teeth, skulls, jaws, limb and other bones, with antlers and horn-cores, belonging to the genera *Cervus*, *Bison*, and *Bos*. Of the first there are seven specimens of the Great Irish Deer, and fifty of the Red Deer, besides thirteen fragments of undetermined species; making an aggregate of seventy objects. The Bison, judging from the paucity of its remains in the collection,—only thirty-four,—was a rare animal, when compared with those of its congener, the large Bos, which exceed 300.

"This evidence of numbers is important as tending to prove that the heavy Bovidæ were either subjected to greater casualties by floods or other causes than the lighter and more fleet Cervidæ, or that they existed in greater numbers and roamed in very much larger herds. It also tends to prove that the Ruminants numerically surpassed the whole of the other Herbivores, the Mammoth alone being comparable in this respect with the Oxen, but surpassing them in size and weight; and compared with which the bones of the Horse and Rhinoceros are but few. This evidence leads to the assumption also that the Rhinoceros was not a common animal in the Pleistocene country whence the bones of the numerous animals deposited at Ilford were derived. For assuming that its habits were similar to those of the existing Rhinoceros, we should expect to meet with its remains generally in places and under conditions better adapted for their preservation, and hence more frequently than those of other co-existing types of Mammalia.

"It is a fact worth noting, that of this assemblage of vertebrate remains it is seldom that two or more bones of the same animal are found in juxtaposition, showing that they did not find their resting-place where the animals died, but have been floated probably for long distances, from the upper tributaries of the ancient Thames, and subsequently deposited in these fluviatile beds. But from whatever distance they may have been conveyed to this particular spot, they have been subjected to no rolling or water-

wearing action; for all the angles and ridges of the bones still retain their original natural sharpness."[13]

If we could once more restore the physical features of the Valley of the Thames as it existed in Pleistocene times, we should doubtless find that all those places along its lower course, where considerable deposits of brick-earth occur and where the remains of the larger Mammalia are found in such abundance, as at Ilford, Grays, Erith, &c., mark the sites of ancient bays formed by the debouchment of side-valleys into the principal one, giving rise in flood-times to eddies into which the floating carcases of land-animals would indubitably be drawn, and would in course of time sink and become entombed in the soft and yielding argillaceous mud beneath.

That many of the remains of land-Mammalia met with in these deposits may have lain for a very long period of time upon the surface of the dry ground before being carried down by floods and entombed in their present resting-place is, I think, rendered highly probable by the following interesting observation made by Mr. Wm. Davies, F.G.S., of the British Museum of Natural History, who writes as follows:—

"During the preparation of fossil remains from the brick-earth, I have had frequent opportunities of noticing points which would otherwise have passed altogether unobserved by any one, as they could only have been seen at the time the specimen was being actually cleared and developed from its sandy or argillaceous matrix.

"I observed, for example, in the skulls of several fossil Oxen numerous shells of the common Land Snails, *Helix nemoralis* and *H. hortensis*, in one instance more than thirty examples, all in good condition.

"I cannot help imagining that these snails, whilst still living, may have found their way into the hollow cavity of the skull through the only aperture (the foramen magnum) for the purpose of hybernation—as is common with all Helices now living in this country—whilst the skull was still lying on the dry land, where it may have been left for a long time after a flood; or, the animal to which it belonged may

[13] See "Notes on the Pleistocene Deposits yielding Mammalian remains in the vicinity of Ilford, Essex." By Henry Woodward, F.R.S., and William Davies, F.G.S. (Geol. Mag., 1874. Decade II., vol. i., pp. 390—398).

perhaps have fallen a prey on that very spot to wild beasts, and afterwards the skull may have been cleared of animal matter by predaceous insects. It seems incredible that such a large number of adult snails could have been washed in by water through so small an aperture, and that one the sole opening into the brain-cavity."[14]

There is one other point which I would wish briefly to notice: it is the question of the origin of the brick-earth. Mr. Whitaker observes (Geol. Surv. Memoir, 'Guide to the Geology of London and the neighbourhood,' 8vo, 1880, p. 65):—

"The origin of this brick-earth is rather doubtful; in some places it seems to be little else than a mixture of rearranged Lower Tertiary Beds, with barely a trace of bedding; whilst in others it is a more or less finely-bedded sandy clay, or clayey sand; on the north it is possible that it may be allied to the deposits next underlying the Boulder-clay, the 'Middle Glacial' of Mr. S. V. Wood."

From its occurrence in large hollows or in pipes let into the Chalk, and being also said by Mr. Whitaker to be often full of flints, and of variable colour from light brown to grey and red-mottled, there can be little doubt that it may be classed with the "clay with flints," or the "*argile à silex*" of the French geologists. Mr. Whitaker says (*op. cit.*, p. 64):—

"The greater part of the higher ground of the chalk-tracts, both on the north-west and south-east, has a covering of a more or less clayey nature; the upper part of this is often worked for bricks. . . . . From the unworn character of the contained flints, the surfaces of some of which are as fresh as if they had come direct from the chalk, we may infer that *the deposit has been formed on the spot where it is now found*, not from materials transported from a distance, but through the dissolving away of the chalk, of which the pipes give evidence. By this process the carbonate of lime of the chalk would be dissolved away, and the insoluble flints and earthy (aluminous) matters left behind, the last receiving, perhaps, an addition from any pre-existing clayey deposit that might occur over the chalk.

"We may conclude, therefore, that the 'clay with flints'

[14] See Appendix 5, p. 70, to Catalogue of the Pleistocene Vertebrata in the Brady Collection. London, 1874.

[and also the brick-earth, H. W.] is not of definite age, but may have been forming at any time *since* the last emergence of the country from the sea (and its consequent subjection to atmospheric agents) to the present time."

This theory of the atmospheric origin of the clay with flints, and so of the brick-earths of the chalk-area, was put forward by my friend, Mr. W. Whitaker, B.A., F.G.S., in the Geological Survey Memoir to Sheet 7, 1864, and I thoroughly endorse his views.

This brick-earth would be slowly formed upon the upper watershed of the Thames and all its tributaries, and by rains and floods would be washed off the surface and brought down into the quiet reaches, together with the bones of land-animals, and land-snails.

The story of the Thames Valley brick-earths is the same as that of the "red-earth" of our ossiferous caverns in limestone districts. The carbonate of lime is dissolved away by the percolation of rain-water charged with carbonic acid, eating out those great swallow-holes, chasms, and caves for which the Mendip Hills, the Peak in Derbyshire, and the limestone districts of Lancashire and Yorkshire are so famous. This red-earth of the caves is only the insoluble (aluminous) residuum of the limestone in which, as in our brick-earths, the relics of prehistoric man and of the animals he saw and hunted have been found.

The following is a list of the Mammalian remains from Ilford, from the collection of the late Sir Antonio Brady, F.G.S., now preserved in the British Museum of Natural History:—

Felis spelæa.
Canis vulpes.
Ursus ferox.
Elephas primigenius.
,, *antiquus.*
Rhinoceros leptorhinus.
,, *megarhinus.*
,, *tichorhinus.*
Equus fossilis.
Megaceros hibernicus.
Cervus elaphus.
,, *sp.*
Bison priscus.
Bos primigenius.
Miscellaneous Ruminant remains.
Hippopotamus.
Undetermined species.

From other collections—made by Sir John Lubbock, Bart., M.P., F.R.S.; Prof. Boyd-Dawkins, F.R.S.; F. C. J. Spurrell, Esq., F.G.S.:—

Ovibos moschatus. The Musk Ox.
Spermophilus. The Pouched Marmot.

List of Animals characteristic of the Pliocene and Quaternary Deposits of Britain and Western Europe:—

Castor europæus, Owen.
[*Trogontherium cuvieri*, Fischer.]
Mus musculus, Owen.
Arvicola amphibia, Owen.
,, *agrestis*, Fleming.
,, *pratensis*, Owen.
Spermophilus citillus, Linn.
,, *erythrogenoides*, Falc.
Lagomys spelæus, Owen.
Lepus timidus, Linn.
,, *cuniculus*, Linn.
Lemmus lemmus, Linn.
Elephas primigenius, Blum.
,, *antiquus*, Falconer.
,, [*meridionalis*, Nesti.]
Rhinoceros tichorhinus, Cuv.
,, *leptorhinus*, Owen.
,, *megarhinus*, Christol.
,, [*etruscus*, Falc.]
Equus caballus, Linn.
Sus scrofa-ferox, Linn.
Hippopotamus major, Nesti.
Bison priscus, Bojanus.
Bos primigenius, Bojanus.
,, *longifrons*, Owen.
Ovibos moschatus, Pallas.
Capra ægagrus, Gmel.
Capra hircus, Linn.
Ovis aries, Linn.
Cervus elaphus, Linn.
,, *capreolus*, Linn.
,, *tarandus*, Linn.
,, *megaceros*, Owen.
,, [*sedgwickii*, Gunn.]
,, [*brownii*, Dawk.]
,, *dama*, Linn.
Alces malchis, Linn.
Machairodus latidens, Owen.
Felis spelæa, Goldf.
,, *antiqua* (*?*).
,, *catus*, Owen.
,, *lynx*.
Hyæna spelæa, Goldf.
Canis lupus, Linn.
,, *vulpes*, Briss.
Lutra vulgaris, Owen.
Mustela martes, Ray.
,, *putorius*, Linn.
,, *erminea*, Linn.
Meles taxus, Owen.
Gulo luscus, Linn.
Ursus spelæus, Blumenbach.
,, *arctos*, Linn.
Talpa europæa, Schmerling.
Sorex vulgaris, Owen.
,, *moschatus*, Linn.
Saiga tartarica, Pallas.

[The names included in square brackets characterise the Norfolk forest-bed.]

II.

The Macro-Lepidoptera of the District around Maldon, Essex.

By Gilbert H. Raynor, M.A.,
Vice-President of the Cambridge Entomological Society.

[Read May 20th, 1882.]

The character of the country round Maldon is of a very varied description, and consequently affords a good hunting-ground to the student of Natural History. To the east lies the Blackwater, the estuary of which is bounded by low-lying alluvial marshes, at the present time mostly under grass, which is grazed by Bullocks, Sheep, and Horses. Here is an absence of all trees, except a few pollard willows along the banks of the ditches bounding the uplands from the marshes—a weary expanse of desolate lands, which tempts us, in the words of the poet,

> "To watch the crisping ripples on the beach,
> And tender curving lines of creamy spray;
> To lend our hearts and spirits wholly
> To the influence of mild-minded melancholy."

The marshes are protected from the tide by an artificial embankment of soil, commonly called a sea-wall. The vegetation of the Salterns, the land outside the wall over which the tide flows every twelve hours, is quite peculiar; yet is it somewhat destitute of insect-life, except in autumn, when the gay masses of *Aster trifolium* throw a golden glory over all the land. These and the flowers of other plants indigenous to the marshes attract several common Noctuæ in considerable numbers; but collecting is far from easy, owing to the network of salt-water rills with which the marshes are intersected. Several Micro-Lepidoptera are attached to these Saltern plants, more especially to *Plantago maritima*, and various species of *Statice* and *Aster*. This district, I regret to say, 1

have never had a chance of working very thoroughly; but, judging from my limited experience, I should say that it is much richer in the Micros than in the larger insects of which I am specially treating in this paper. My collecting has been done chiefly inland, Hazeleigh, 2½ miles S.W. of Maldon, being the head-quarters. The other parishes to which I have given special attention are, besides Maldon itself—Danbury, 5 miles W.; Purleigh, 4 miles S.; Mundon, 3 miles S.S.E.; Woodham Mortimer, 2½ miles W.; Woodham Walter, 3 miles W.; and Woodham Ferrers, 6 miles S.W.

The prevailing flora is that usually found on a clayey soil: Danbury, however, stands on a light gravelly soil which produces many peculiar plants, and several that are of considerable rarity in the county. A short sketch of the botanical characteristics of the district, with especial reference to such plants as Lepidoptera are partial to, will perhaps not be out of place. The elm is undoubtedly the tree which flourishes most, the soil being especially suited to its growth; it may be seen along the hedgerows and roads throughout this district, and its variety or congener, the wych-elm (*Ulmus montana*), is by no means uncommon, and is a peculiarly graceful tree. Its English name is not owing to any sinister quality associated with the tree, but, according to its derivation, signifies pendulous or drooping; and is etymologically connected with wicker-work, both being attributable to the root in Anglo-Saxon, wic-an, to bend.

The oak is also fairly abundant, much more so than in many parts of the eastern counties. Nearly all the woods in this part consist of oaks, but out of woods one notices specimens only here and there. Maple is very abundant in hedges, but does not often attain a considerable size. Pines are almost entirely absent, especially close to Maldon—a fact which makes the record of a true pine-feeding species (*Thera variata*) worthy of special notice. The alder is a rare tree, being found occasionally on the banks of the Navigation, between Maldon and Chelmsford, and also near the railway-line at Langford; nor does its close ally, the birch, flourish to any great extent. It is to be found growing singly in

woods, but hardly to a sufficient extent to produce real birch-feeding species. At Danbury, especially towards Little Baddow, it is common enough, but generally in places that are not very accessible after dark. Willows may be found in most parts of the district, but they do not seem to attain to large dimensions; the sallow is also frequent, and, as a good deal of the land is low-lying, is often very luxuriant in its growth. The hedges about here are composed chiefly of blackthorn, maple, and whitethorn, the first-named being more abundant than in most districts. Hornbeam is common, as a shrub, especially in woods; pollards, such as abound in Epping Forest, are not to be found in this district.

Broom is of very general occurrence, and is particularly abundant round Danbury. *Clematis*, which, according to Gibson's 'Flora of Essex,' occurs abundantly at Maldon, is in my experience very rare in the district. There is a little at Danbury, and still less at Hoe Mill; when you get into the Witham district it is quite common. Near Witham I have frequently obtained *Iodis vernaria* and other species that affect *Clematis*, but have never met with them in the district of which I am now treating.

I shall now proceed to give a brief sketch of the Lepidoptera that occur round Maldon, as observed by myself during a period of seven years, from 1872 to 1876, and during 1880, 1881, and 1882. The list is probably incomplete to a large extent, as must necessarily be the case in a district where there is a paucity of working entomologists. Our Vice-President, Mr. E. A. Fitch, F.L.S., of Brick House, Maldon, has kindly sent me a list of the rarer species that he has observed, chiefly on his own land, and from this I have been able to add twenty-three species to my list. The other species, with the exception of *Papilio machaon*, *Vanessa c-album*, and *Coremia quadrifasciaria*, have all been taken by myself. The absence of many ordinary species, such as *Amphidasys betularia* from the Geometræ, and *Dianthœcia carpophaga* from the Noctuæ, will at once strike those who study the list. They are very possibly present, but I have hitherto failed to discover them.

Taking the butterflies first, it will be found that thirty-eight occur in the district. This is a very fair proportion out of a total of sixty-six, which is the number contained in the British list; but which includes at least two extinct species, and two, if not more, that occasionally leave their continental homes and visit British shores. If we further eliminate extremely local species, such as *M. cinxia*, *E. cassiope*, *Thecla pruni*, and several others, thirty-eight becomes a very good total for any single district. It is a total, however, to which I think it would be difficult to add a single species, as butterflies almost force themselves on one's notice, and, except in the case of a very local insect like *N. lucina*, are not likely to be overlooked.

Considering the Diurni rather more in detail, we find that *Papilio machaon*, *Vanessa c-album*, *V. antiopa*, and *Arge galathea* are only stragglers. When the first of these was taken at Maldon, in 1872, I had only just come to live in that part of Essex, and being imperfectly acquainted with the marshes that exist round Maldon I hazarded the conjecture that *machaon* might breed in the vicinity; but I have long ceased to believe in the probability of this. *Vanessa antiopa* occurred in the great "*antiopa* year," when this butterfly was observed throughout the length and breadth of the land. The occurrence of a single specimen of *Arge galathea* is remarkable, and difficult of explanation. It is an insect naturally slow on the wing, and generally found in great numbers where it occurs. It was doubtless a straggler that visited Hazeleigh only under the compulsion of strong winds or other irresistible necessity.

The two English representatives of the genus *Colias* occur, sometimes in abundance, near Maldon. Why they appear and disappear so suddenly has always been a puzzle to naturalists. That they come over in vast numbers from the Continent never seemed very probable to me, and the falsity of this theory was proved conclusively to myself by the capture of a deformed specimen of *Colias hyale* at Woodham Mortimer in 1875. One of its wings was so distorted as to have made it impossible for the insect to have flown

any considerable distance: it must have been bred on the spot.

The next class of butterflies includes those that may be termed "local and rare," including *Vanessa polychloros*, *Thecla w-album*, *T. betulæ*, and *Nemeobius lucina*. The first two are of general occurrence round Maldon, the two latter very restricted in their habitat. Beyond these species, nothing occurs that is worthy of very special remark. The "Fritillaries" are fairly represented, but the larger species are not common. *Vanessa cardui* is sometimes abundant in the spring, but I have never noticed very many in the autumn. Of the genus *Thecla* every species, except *T. pruni*, is to be found. *Thecla rubi*, being a broom-feeder, occurs commonly, and *T. quercus* abounds in oak woods. Of the "Blues," *Lycæna argiolus* is the most interesting: its food-plant is abundant, but the butterfly itself never seems to occur in any numbers. *Hesperia comma* is absent from the list, but may possibly occur at Danbury.

The next great division of Lepidoptera, the Nocturni, is represented with us by exactly fifty species. All the more ordinary "hawk-moths" occur, including *Acherontia atropos* (which one would expect to be commoner round Maldon, as it is abundant near Southend) and *Sphinx convolvuli*, which occurred singly in 1875, when the species occurred in such numbers in this country. Of the clear-wings I have not come across any really rare species, but *Sesia ichneumoniformis* cannot be considered a common insect. *Limacodes testudo*, *Nola strigula*, and *Lithosia quadra* next attract our attention: they have not occurred in any numbers, and evidently only just succeed in maintaining themselves. *Orgyia fascelina*, an insect much commoner in the North of England, used to be abundant on the hedges lining a certain part of the road from Maldon to Danbury. I find a record in my diary of having taken as many as sixty larvæ in 1872; and I continued to find the species there till 1875. The nature of the locality has not changed in any way, and I am quite at a loss to account for the disappearance of this species. Of the remaining Nocturni, *Trichiura crataegi* and *Gastropacha querci-*

folia are perhaps the most interesting. The former is abundant on hedges, feeding on both white- and black-thorn. It is frequently recorded as being a wood insect, but I have only once found it in a wood, when it was feeding on, or at any rate came off, oak.

One hundred and sixteen is the sum total of the Geometræ hitherto observed. *Pericallia syringaria* and *Eurymene dolabraria* both occur sparingly; and the "Thorns" are represented by two good species, *Selenia lunaria* and *Ennomos erosaria*, although these have only occurred singly. The "Essex Emerald," belonging to the typical genus *Geometra*, has altogether eluded the search both of Mr. Fitch and myself, but should occur along the sea-wall near Maldon. *Phorodesma bajularia* is no rarity in oak-woods, but flies high. Mr. Fitch records two noteworthy *Acidaliæ*—*A. emutaria*, and *A. inornata*. *Aleucis pictaria*, first discovered at Colchester, seems to occur wherever I have netted during the early part of April. *Larentia multistrigaria* is said to be a common insect, but it certainly is not so in our part of Essex. Of *Emmelesia* we have four species, *E. unifasciata* being the best. The *Eupitheciæ* have, I fear, been rather neglected, fourteen being the tale. These are mostly common species, *E. albipunctata* and *E. coronata* being the most remarkable. *Anticlea rubidata* is not so abundant as the frequent presence of its food-plant, *Galium mollugo*, would lead one to expect. *Coremia quadrifasciaria* is recorded in the 'Entomologist' as having been taken at Danbury, where I have myself taken a single specimen of *Scotosia undulata*. *Cidaria picata* is common, so are the two species of *Chesias* amongst broom.

The Drepanulidæ are represented by two species only, *Platypteryx hamula* occurring regularly, but not in any numbers. The Maldon district is not rich in the "Prominents," even ordinary species like *Notodonta ziczac* and *N. camelina* being somewhat rare.

Proceeding to the Noctuæ we find that *Cymatophora flavicornis* occurs near Maldon, in a district where birches are to be found in gardens only. *Tridens* and *ligustri* are the best species of *Acronycta*. *Leucania comma*, so abundant in some

places, is here decidedly rare, generally occurring singly; this I have also found to be the case in Cambridgeshire. The rarest insect included in my list is doubtless *Xylomiges conspicillaris*. It has also been taken at Brentwood in this county, and probably only wants looking for. But how? Its habits seem little known, most English specimens resulting from dug pupæ. *Neuria saponariæ* next attracts attention; after that we meet with nothing of any particular interest until we come to *Agrotis ravida*, which has occurred frequently, but cannot be said to be common.

The genus *Tæniocampa* has seven representatives, *T. rubricosa* and *T. gracilis* being both of rare occurrence in this district. *Orthosia ypsilon* occurs now and then, and would doubtless prove more abundant if worked for regularly among willows.

I have succeeded in finding every species of *Xanthia*. *Xanthia gilvago* and *X. aurago* are both of very limited distribution in England; the former is, I fancy, more generally distributed than is usually supposed; I have met with it myself at many places in the eastern counties. It may be obtained in the larval state by beating the flowers and seeds of the wych-elm from the middle of April till the beginning of June. *X. aurago* I took a single specimen of at ivy-bloom in 1880. The remarks I have just made with regard to distribution apply equally to *Eremobia ochroleuca*, which I have noticed in many places in this part of England. *Tethea subtusa*, a species I have never come across, is recorded by Mr. Fitch. *Euperia fulvago* is known as an inhabitant of the Maldon district from a single specimen taken by myself at sugar on the top of Hazeleigh Hill,—a most exposed situation,—although it is generally regarded as a wood-insect. The pretty elm-feeding species of *Cosmia* are both abundant, and *Aplecta advena* is far from rare at flowers. The only rare *Hadena* met with is *H. genistæ*, which is probably of common occurrence; it is an insect not often seen, except at rest on fences. *Xylina semibrunnea* occurs sparingly at ivy-blossom. The genus *Cucullia* is only represented by the two common species: in fact, from this point

to the end of the list there is no species that calls for special comment.

The Noctuæ recorded amount to 128,—not a very large number, but perhaps as many as one could expect to find in a district of the character of that under consideration. I think that hard night-work might perhaps add some twenty species to this list. It may almost be assumed that some of the better "Wainscots" occur on the swampy ground near Maldon; and that several regular oak- and birch-feeders exist at Danbury.

Appended is a list of all the species hitherto discovered round Maldon, with short notes on those that call for special remark:—

Diurni.

Papilio machaon, L.—A single specimen in 1882. Recorded in 'Entomologist,' Oct., 1872, pp. 223–4.

Pieris brassicæ, L.—Common, but rarely appears in great abundance.

P. rapæ, L.—Very common.

P. napi, L.

Anthocharis cardamines, L.—Abundant.

Gonepteryx rhamni, L.—Fairly common, although *Rhamnus*, its ordinary food-plant, is scarce.

Colias edusa, F.; C. hyale, L.—Abundant in certain years, when they are generally distributed in the district, but commoner near Maldon. Most plentiful in clover and lucerne fields. In 1875 both species were abundant. In 1877 my brother, Mr. A. G. S. Raynor, took a specimen of *C. edusa*, var. *helice*, at Hazeleigh.

Argynnis paphia, L.—Hazeleigh Wood; rare.

A. adippe, S. V.—Occurs sparingly in Parson's Wood, near Woodham Mortimer Church.

A. euphrosyne, L.—Danbury, common; Woodham Ferrers Hall Wood, abundant.

A. selene, S. V.—Woodham Ferrers Hall Wood; plentiful.

Vanessa c-album, L.—Mundon. One specimen taken by Mr. R. E. Stuart. Recorded Ent., Dec., 1872, p. 264.

V. urticæ, L.

V. polychloros, L.—Occurs very generally. The larvæ, being gregarious when young, strip whole elm-branches, and are very conspicuous.

V. antiopa, L.—Maldon. One specimen recorded Ent., Oct., 1872, p. 216. In the autumn of 1872 this species was

quite common in England, and was recorded from the following places near Maldon: Bradwell-on-Sea, Latchingdon, Burnham, and Mundon. The only specimen since taken was captured in 1879 by Mr. S. Williams at Cold Norton.

V. IO, L.

V. ATALANTA, L.

V. CARDUI, L.—Apparently not so abundant as formerly. Occurs regularly on the summit of Loddart's Hill, Hazeleigh.

ARGE GALATHEA, L.—Hazeleigh. A single specimen only, some years since.

SATYRUS ÆGERIA, L. — Hazeleigh; Purleigh; Danbury; Woodham Ferrers Hall Wood.

S. MEGÆRA, L.

S. JANIRA, L.

S. TITHONUS, O.—Very abundant.

S. HYPERANTHUS, L.—Abundant, but somewhat local.

CŒNONYMPHA PAMPHILUS, L.

THECLA RUBI, L.—Of general occurrence. In some plenty at Danbury.

T. QUERCUS, L.—Danbury; Hazeleigh; Purleigh; Woodham Ferrers. In oak-woods, common. Imago is also fond of settling on young ashes; larvæ occasionally on sallow.

T. W-ALBUM, Kn.—Very abundant in the district, extending from Danbury to St. Lawrence. Imago on bramble-flowers; larvæ prefer wych-elm.

T. BETULÆ, L.—Hazeleigh; Mundon. Rare; generally in larval state.

POLYOMMATUS PHLÆAS, L.—Common. The second brood is always more abundant than the first.

LYCÆNA AGESTIS, S. V.—Hazeleigh. Sometimes common, but is local.

L. ALEXIS, S. V.

L. ARGIOLUS, L.—Danbury; Hazeleigh; Woodham Mortimer. Never abundant, but fairly common at Danbury.

NEMEOBIUS LUCINA, L. — Woodham Ferrers Hall Wood. Common, but local.

SYRICTHUS ALVEOLUS, H.—Danbury; Hazeleigh; Woodham Ferrers.

THANAOS TAGES, L.—Woodham Ferrers. Fairly common.

HESPERIA SYLVANUS, L.—Very abundant.

H. LINEA, S. V.—Occurs in great abundance, especially at Hazeleigh. This species does not seem to be decreasing in numbers, as is the case in many other localities.

NOCTURNI.

SMERINTHUS OCELLATUS, L.—Generally distributed, but not very common.

S. POPULI, L.—Danbury; Hazeleigh: Woodham Ferrers. Larvæ generally on willow or sallow. Poplars are of very rare occurrence in the district.

S. TILIÆ, L.—Hazeleigh: Maldon.

SPHINX CONVOLVULI, L.—One specimen at Hazeleigh Rectory in 1875.

S. LIGUSTRI, L.—Hazeleigh; Danbury. Not common.

ACHERONTIA ATROPOS, L.—Maldon. One larva in 1877, two in 1881. (Mr. E. A. Fitch).

CHŒROCAMPA PORCELLUS, L. — Maldon. Occasionally at honeysuckle. (Mr. E. A. Fitch).

C. ELPENOR, L.—Maldon; Woodham Mortimer; Woodham Walter. Larvæ on *Epilobium hirsutum*; very rarely on *Galium mollugo*.

MACROGLOSSA STELLATARUM, L. — In some years common; not observed frequently of late.

SESIA MYOPIFORMIS, Bk. — Hazeleigh; Maldon, not uncommon.

S. ICHNEUMONIFORMIS, F.—Hazeleigh, one imago in 1874. As hellebore does not occur, its food-plant with us is, I presume, *Lotus corniculatus*.

S. TIPULIFORMIS, L.—Hazeleigh; Maldon. Probably occurs generally in old gardens.

ZEUZERA ÆSCULI, L.—Hazeleigh; Maldon.

COSSUS LIGNIPERDA, F.—Occurs generally.

HEPIALUS HECTUS, L.—Frequents two woods in Hazeleigh.

H. LUPULINUS, L.—Common.

H. SYLVINUS, L.—Hazeleigh Wood.

LIMACODES TESTUDO, S. V. — In two woods in Hazeleigh. Beaten from oak.

ZYGÆNA FILIPENDULÆ, L.—Hazeleigh. Confined to a very small area.

NOLA CUCULLATELLA, L.—Common, especially in the larval state.

N. STRIGULA, S. V.—Hazeleigh Wood. Once only.

HALIAS PRASINANA, L.—Woodham Ferrers.

NUDARIA SENEX, H.—Hazeleigh. A single specimen.

N. MUNDANA, L.—Hazeleigh; Purleigh.

CALLIGENIA MINIATA, Forst.—Hazeleigh Wood. Not common.

LITHOSIA MESOMELLA, L.—Hazeleigh; Purleigh.

L. LURIDEOLA, Tr.—Common.

L. GRISEOLA, H.—The commonest of the genus.

L. QUADRA, L.—Hazeleigh Wood. Once only.

EUCHELIA JACOBEÆ, L. — Hazeleigh, once. Maldon, three or four larvæ taken by Mr. E. A. Fitch. The sparing occurrence of this species is remarkable. Where it is found it is generally abundant.

CHELONIA CAJA, L.—Fairly abundant.

ARCTIA MENDICA, L.—Hazeleigh; scarce.

A. LUBRICIPEDA, L.

A. MENTHASTRI, S. V.

LIPARIS CHRYSORRHŒA, L. — In the larval state is common in the district.

L. AURIFLUA, F.

L. SALICIS, L.—Maldon, common. Hazeleigh, introduced; has flourished for ten years.

ORGYIA PUDIBUNDA, L.—Hazeleigh. Probably general.

O. FASCELINA, L.—Woodham Walter. Used to be abundant a few years since, but I have failed to find it lately.

O. ANTIQUA, L.

TRICHIURA CRATÆGI, L. — Hazeleigh; Maldon; Woodham Mortimer; Woodham Ferrers.

PŒCILOCAMPA POPULI, L.—Maldon; at light.

ERIOGASTER LANESTRIS, L.—Common in larval state.

BOMBYX NEUSTRIA, L,—Very abundant.

B. RUBI, L.—Danbury; larvæ found occasionally.

B. QUERCUS, L.—Abundant.

ODONESTIS POTATORIA, L.—Very common.

LASIOCAMPA QUERCIFOLIA, L. — Danbury; Hazeleigh; Purleigh. Larvæ generally on blackthorn.

SATURNIA CARPINI, S. V. — Hazeleigh; Woodham Walter. Larvæ on whitethorn and sallow.

GEOMETRÆ.

OURAPTERYX SAMBUCATA, L.—Common.

EPIONE APICIARIA, S. V.—Hazeleigh; rare.

RUMIA CRATÆGATA, L.

VENILIA MACULATA, L. — Danbury; Woodham Ferrers; Woodham Walter. Abundant, but local.

ANGERONIA PRUNARIA, L.—Hazeleigh Wood; common.

METROCAMPA MARGARITATA, L.—Common.

EURYMENE DOLABRARIA, L. — Hazeleigh. Not uncommon; generally among oaks in woods.

PERICALLIA SYRINGARIA, L.—Hazeleigh Wood. Not abundant.

SELENIA ILLUNARIA, H.

S. LUNARIA, S. V. — Hazeleigh. One specimen resulting from a larva beaten off maple in 1881.

Crocallis elinguaria, L.
Ennomos tiliaria, Bk.—Maldon; at light.
E. erosaria, S. V.—Hazeleigh; once in 1880.
E. angularia, S. V.—Danbury. Hazeleigh, common.
Himera pennaria, L.—Hazeleigh Wood; Woodham Ferrers. In larval state.
Biston hirtaria, L.—Maldon; common at light.
Hemerophila abruptaria, Thnb.—Danbury.
Cleora lichenaria, Hf.—Hazeleigh Wood.
Boarmia repandata, L.
B. rhomboidaria, S. V.
Tephrosia crepuscularia, S. V.—Danbury.
Pseudoterpna cytisaria, S. V.—Danbury; Woodham Ferrers; Woodham Walter.
Iodis lactearia, L.—Common in woods.
Phorodesma bajularia, S. V.—Hazeleigh; Purleigh. Not rare; flies high at dusk round oak-trees. The larva, which I have beaten in the autumn, hybernates.
Hemithea thymiaria, L.—In woods.
Ephyra porata, F.—Danbury; Hazeleigh Wood; Woodham Ferrers.
E. punctaria, L.—Danbury; Woodham Ferrers.
E. omicronaria, S. V.—Common.
Asthena luteata, S. V.—Danbury; Hazeleigh; Woodham Ferrers; Woodham Mortimer. Local.
A. candidata, S. V.—Common in woods.
Acidalia scutulata, S. V.
A. bisetata, Hf.
A. trigeminata, Hw.—Hazeleigh Wood.
A. osseata, S. V.—Maldon. (Mr. E. A. Fitch).
A. incanaria, H.—Common.
A. remutata. H.
A. imitaria, H.—Hazeleigh; Woodham Mortimer. Common.
A. inornata, Hw.—Maldon. One specimen taken by Mr. E. A. Fitch.
A. emarginata, L.—Hazeleigh, common. Probably general.
Timandra amataria, L.—Common.
Cabera pusaria, L.
C. exanthemaria, S.
Corycia temerata, S. V.—Danbury; Hazeleigh Wood; Purleigh.
Aleucis pictaria, C.—Very general, but most abundant at Purleigh.
Halia vauaria, L.—Danbury.
Strenia clathrata, L.—Common, especially among clover and lucerne.

Panagra petraria, H. — Hazeleigh Wood; Woodham Ferrers.

Fidonia atomaria, L.—Danbury.

Abraxas grossulariata, L.

Ligdia adustata, S. V.—Hazeleigh; Purleigh.

Lomaspilis marginata, L.

Hybernia rupicapraria, S. V.

H. leucophearia, S. V.—Maldon. (Mr. E. A. Fitch).

H. progemmaria, H.

H. defoliaria, L.

Anisopteryx æscularia, S. V.

Cheimatobia brumata, L.

Oporabia dilutata, S. V.

Larentia didymata, L.

L. multistrigaria, Hw. — Hazeleigh. A single specimen in 1873.

L. pectinitaria, Fu.

Emmelesia affinitata, Sg.—Hazeleigh Wood.

E. albulata, S. V.—Maldon; amongst *Rhinanthus*. (Mr. E. A. Fitch).

E. decolorata, H.—Hazeleigh Wood; common.

E. unifasciata, H.—Hazeleigh; Woodham Ferrers. Singly.

Eupithecia linariata, S. V. — Danbury; Woodham Mortimer. Local.

E. centaureata, S. V.—I have taken this species at sugar.

E. succenturiata, L.—Maldon. (Mr. E. A. Fitch).

E. subfulvata, Hw. — Danbury; Hazeleigh; Woodham Mortimer.

E. castigata, H.

E. albipunctata, Hw. — Hazeleigh; Woodham Ferrers. Locally abundant.

E. pimpinellata, H.—Maldon. (Mr. E. A. Fitch).

E. vulgata, Hw.

E. absinthiata, L. — Larvæ common, feeding on almost everything.

E. assimilata, Db.—Hazeleigh.

E. exiguata, H.—Among whitethorn.

E. pumilata, H.—Hazeleigh; Danbury; Purleigh; Woodham Ferrers; Woodham Mortimer. Larvæ on bramble flowers.

E. coronata, H.—Danbury; Hazeleigh.

E. rectangulata, L.

Lobophora hexapterata, S. V. — Woodham Ferrers, occasionally.

L. lobulata, H.—Danbury.

Thera variata, S. V.—Maldon; one at a lamp-post in 1873.

Hypsipetes elutata, H.

Melanthia rubiginata, S. V.—Beeleigh.
M. ocellata, L.—Common.
Melanippe tristata, M. — Several specimens on Brick House Farm, Maldon. (Mr. E. A. Fitch).
M. unangulata, Hw. — Danbury; Hazeleigh; Purleigh; Woodham Ferrers; Woodham Mortimer.
M. rivata, H.
M. sociata, Bk.
M. montanata, S. V.
M. fluctuata, L.
Anticlea rubidata, S. V.—Hazeleigh; not common.
A. badiata, S. V.—Very common.
A. derivata, S. V.—Common.
Coremia propugnata, S. V. — Danbury; Hazeleigh; Purleigh; Woodham Mortimer.
C. ferrugata, L.
C. unidentaria, Hw.
C. quadrifasciaria, G.—Danbury.
Camptogramma bilineata, L.
Scotosia dubitata, L.—Hazeleigh.
S. rhamnata, L.—Purleigh.
S. undulata, L.—Danbury. Once.
Cidaria miata, L.
C. picata, H.—Danbury; Hazeleigh; Purleigh; Woodham Ferrers; Woodham Mortimer. Fairly common.
C. corylata, Thnb.
C. russata, S. V.
C. suffumata, S. V.—Very abundant, but does not seem to vary in markings.
C. fulvata, Fors.
C. pyraliata, S. V.
C. dotata, L.—Maldon. Not uncommon. (Mr. E. A. Fitch).
Eubolia cervinaria, S. V.—Maldon; at light.
E. mensuraria, S. V. — Danbury; Hazeleigh; Woodham Ferrers.
E. palumbaria, S. V.—Danbury; Purleigh.
Anaitis plagiata, L.—In woods.
Chesias spartiata, F.—Danbury; Woodham Walter.
C. obliquaria, S. V. — Woodham Walter. This species seems to appear early in April, not in May, as is generally supposed.

Drepanulidæ.

Platypteryx hamula, S. V. — Hazeleigh; Woodham Ferrers. Occurs regularly, but is not common.
Cilix spinula, L.

Pseudo-Bombyces.

Dicranura furcula, L.—Hazeleigh; in larval state.

D. vinula, L.

Pygæra bucephala, L.

Clostera curtula, L. — Hazeleigh Rectory; Woodham Ferrers. Common in larval state.

C. reclusa, S. V. — Maldon; two specimens bred by Mr. E. A. Fitch.

Ptilodontis palpina, L.—Hazeleigh; Maldon.

Notodonta camelina, L. — Hazeleigh Wood; Woodham Ferrers. In larval state.

N. dictæa, L.—Maldon.

N. ziczac, L.—Larvæ on sallows. (Mr. E. A. Fitch).

Diloba cæruleocephala, L.—Larvæ very abundant.

Noctuæ.

Thyatira derasa, L.—Hazeleigh. Not common.

T. batis, L.—Hazeleigh. Scarce.

Cymatophora duplaris, L.—Hazeleigh Wood.

C. flavicornis, L.—One specimen bred; one found at rest at the Friary, Maldon, in 1877. (Mr. E. A. Fitch).

Acronycta tridens, S. V.—Maldon; in larval state.

A. psi, L.

A. aceris, L. — Woodham Mortimer; one at rest on a willow.

A. megacephala, S. V.—Hazeleigh.

A. ligustri, S. V.—Two specimens bred from pupæ found near Brick House, Maldon. (Mr. E. A. Fitch).

A. rumicis, L.

Leucania conigera, S. V.—Common at flowers.

L. lithargyria. E.—Hazeleigh; Purleigh.

L. comma, L.—Hazeleigh; Maldon. Scarce.

L. impura, H.

L. pallens, L.

Nonagria fulva, H.—Maldon; at light.

N. typhæ, E.—Hazeleigh; Maldon; Woodham Ferrers.

Hydrœcia nictitans, L.—Hazeleigh; at sugar.

H. micacea, E.—Hazeleigh; Maldon.

Axylia putris, L.—Hazeleigh.

Xylophasia rurea, F.—Hazeleigh; Purleigh. Rare.

X. lithoxylea, S. V. — Hazeleigh; Purleigh; Woodham Mortimer.

X. sublustris, E.—Woodham Mortimer; once.

X. polyodon, L.

Xylomiges conspicillaris, L. — One on the confines of

Danbury and Woodham Ferrers. 'Entomologist,' July, 1873, p. 427.

Neuria saponariæ, Bk. — One specimen, in 1879, captured on the sea-wall, Maldon, by Mr. E. A. Fitch.

Cerigo cytherea, F. — Danbury; Hazeleigh; Purleigh; Woodham Mortimer.

Luperina testacea, S. V.—Very common.

Mamestra anceps, H.—Hazeleigh; Woodham Mortimer.

M. brassicæ, L.

M. persicariæ, L.

Apamea basilinea, S. V.—Hazeleigh. Not common.

A. gemina, H. — Maldon. Not uncommon. (Mr. E. A. Fitch).

A. oculea, F.

Miana strigilis, L.

M. fasciuncula, Hw.

M. literosa, Hw.

M. arcuosa, Hw.—Maldon; two or three. (Mr. E. A. Fitch).

Grammesia trilinea, S. V.—Hazeleigh; Purleigh; Woodham Mortimer.

Caradrina morpheus, Hf.—Hazeleigh; Woodham Mortimer.

C. alsines, Bk.—Maldon; common. (Mr. E. A. Fitch).

C. blanda, S. V.—Maldon; rare. (Mr. E. A. Fitch).

C. cubicularis, S. V.

Rusina tenebrosa, H. — Hazeleigh, common; Purleigh; Woodham Mortimer.

Agrotis puta, H.—Hazeleigh.

A. suffusa, S. V.—Hazeleigh; scarce.

A. saucia, H.—Hazeleigh; once.

A. segetum, S. V.

A. exclamationis, L.

A. nigricans, L. — Hazeleigh, common; Purleigh; Woodham Mortimer.

A. ravida, S. V.—Hazeleigh; rare. Generally at rest.

Triphæna ianthina, S. V.—Hazeleigh; Woodham Ferrers; Woodham Mortimer.

T. fimbria, L. — Hazeleigh, rare; Woodham Ferrers, common.

T. interjecta, H.—Danbury; Hazeleigh; Woodham Mortimer.

T. orbona, Hf.

T. pronuba, L.

Noctua augur, F.

N. plecta, L.—Hazeleigh; Purleigh; Woodham Mortimer.

N. c-nigrum, L.

N. triangulum, Hf.—Hazeleigh.

N. FESTIVA, S. V.—Hazeleigh; Purleigh.
N. RUBI, V.—Hazeleigh; Woodham Walter.
N. UMBROSA, H.—Hazeleigh; rare.
N. BAJA, S. V.—Hazeleigh.
N. XANTHOGRAPHA, S. V.
TÆNIOCAMPA GOTHICA, L.
T. RUBRICOSA, S. V.—Hazeleigh; rare.
T. INSTABILIS, S. V.
T. STABILIS, S. V.
T. GRACILIS, S. V.—Danbury; Hazeleigh. Scarce.
T. MUNDA, S. V. — Maldon. One at gooseberry-bloom in April, 1875. (Mr. E. A. Fitch).
T. CRUDA, S. V.—Very abundant.
ORTHOSIA YPSILON, S. V.—Hazeleigh.
O. LOTA, L.
O. MACILENTA, H.—Danbury; Hazeleigh; Woodham Mortimer.
ANCHOCELIS RUFINA, L. — Danbury, common; Hazeleigh; Woodham Mortimer.
A. PISTACINA, S. V.
A. LUNOSA, Hw.—Maldon; at light.
A. LITURA, L.—Danbury; Woodham Mortimer.
CERASTIS VACCINII, L.
C. SPADICEA, G.—Not abundant.
SCOPELOSOMA SATELLITIA, L.
XANTHIA CITRAGO, L.—Danbury.
X. CERAGO, S. V.—Danbury; Hazeleigh.
X. SILAGO, H.—Danbury; Hazeleigh.
X. AURAGO, S. V. — Woodham Mortimer. One at ivy-blossom in 1880.
X. GILVAGO, E.—Hazeleigh; local.
X. FERRUGINEA, S. V. — Danbury; Hazeleigh; Woodham Mortimer.
TETHEA SUBTUSA, S. V. — I believe I have one specimen, taken at Maldon. (Mr. E. A. Fitch).
EUPERIA FULVAGO, S. V.—One taken at sugar, at Hazeleigh, in 1881.
COSMIA TRAPEZINA, L.
C. DIFFINIS, L. — Danbury; Hazeleigh; Purleigh; Woodham Mortimer.
C. AFFINIS, L. — Occurs generally, although not in such numbers as *diffinis*.
EREMOBIA OCHROLEUCA, S. V.—Danbury; Hazeleigh; Maldon; Purleigh; Woodham Mortimer. Common in some seasons; occurs at rest on various flowers, but chiefly on *Centaurea nigra*.

Dianthœcia capsincola, S. V.—Hazeleigh; Maldon.

Polia flavicincta, S. V. — Maldon; at light. Mr. Fitch has found the larva feeding on *Magnolia*.

Miselia oxyacanthæ, L.

Agriopis aprilina, L.—Danbury; Woodham Ferrers.

Phlogophora meticulosa, L.

Aplecta occulta, L.—Hazeleigh. One at sugar in 1881.

A. tincta, Brahm.—Hazeleigh; once.

A. advena, S. V.—Hazeleigh; common at flowers, especially at *Cotoneasters*.

Euplexia lucipara, L.—Hazeleigh; scarce.

Hadena proteus, S. V.—Danbury; Hazeleigh. Common.

H. dentina, S. V.

H. oleracea, L.

H. pisi, L.

H. thalassina, Bk.—Chiefly in woods.

H. genistæ, Bk.—Hazeleigh; once, at rest.

Xylocampa lithorhiza, Bk. — Danbury; Hazeleigh; Purleigh; Woodham Mortimer. Generally at rest on tree-trunks.

Xylina semibrunnea, Hw.—Hazeleigh; rare.

Cucullia verbasci, L. — Maldon. Larvæ common in gardens.

C. umbratica, L.

Anarta myrtilli, L.—Danbury.

Heliodes arbuti, F. — Danbury; Woodham Ferrers; Woodham Mortimer.

Habrostola urticæ, H.—Danbury; Hazeleigh.

H. triplasia, L. — Hazeleigh; Woodham Mortimer. Occasionally.

Plusia chrysitis, L.

P. iota, L.—Maldon; several at honeysuckle. (Mr. E. A. Fitch).

P. gamma, L.

Gonoptera libatrix, L.

Amphipyra pyramidea, L.—Danbury; Hazeleigh; Purleigh; Woodham Ferrers; Woodham Mortimer. Very common.

A. tragopogonis, L.

Mania typica, L.

M. maura, L.

Catocala nupta, L. — Common, except in 1882, when I only saw a couple of specimens.

Euclidia mi, L.—Danbury; Woodham Ferrers.

Phytometra ænea, S. V.—Danbury; Hazeleigh; Purleigh; Woodham Mortimer.

III.

On Deneholes.

By T. V. Holmes, F.G.S., M.A.I.

[Read October 28th, 1882.]

Plates I. and II.[1]

It appears to me that the great majority of ancient "Deneholes and artificial caves with vertical entrances"—to adopt the title of Mr. Spurrell's excellent paper[2]—may be grouped either with the flint-workings of Cissbury and Grimes Graves, near Brandon, or with the Deneholes (*den*-holes) of Bexley and Grays. Numerous pits, scattered over the chalk of South-Eastern England, show affinities more or less pronounced with one or other of these two classes; while others exist the primary purpose of which is now doubtful, in consequence of the modifications they have undergone from time to time. The chalk, at once soft and easily worked, yet firm and coherent, and containing in its upper beds bands of flint invaluable in the Stone ages, was excavated for a variety of purposes. In addition to workings below the surface, any person who may visit one of the grandest specimens of a hill-fort, Maiden Castle, near Dorchester, will there see the steep slopes, rising fifty or sixty feet above the ditches that separate them, looking as even and fresh as though they were the work of the present century rather than of prehistoric times. The ease, or comparative ease, with which chalk could be worked with primitive implements is, no doubt, one of the chief reasons of the abundance of hill-forts or cities in a chalk country. Chalk, indeed, had an influence

[1] [The Club is indebted to Mr. Holmes's generosity for the two plates accompanying this paper. An account of the two preliminary visits made to the Hangman's Wood Deneholes will be found in the 'Proceedings,' under dates June 17th and September 9th, 1882.—Ed.]

[2] 'Archæological Journal,' 1881.

in attracting population in the Stone periods analogous to that of coal in this present iron age.

A brief account of the leading characteristics of the ancient flint-workings at Brandon and Cissbury will show in what respects they resemble and in what they differ from the pits visited by the Essex Field Club at Hangman's Wood, and those which are so numerous south of the Thames in the neighourhood of Bexley.

The assemblage of pits known as Grimes Graves is about three miles N.E. of Brandon, a town close to the borders of Norfolk and Suffolk. Canon Greenwell states[3] that the pits are about 254 in number, and generally about twenty-five feet apart. They are circular, vary in diameter from twenty to sixty-five feet, and have all been filled up to within four feet of the surface; the older pits having received the material brought up out of the newer ones. That examined by Canon Greenwell was twenty-eight feet in diameter at the top and twelve feet at the bottom, which was thirty-nine feet below the surface. The shaft was sunk through thirteen feet of dark yellow sand, which formed the surface, and below that was in chalk. The depth of the pit was determined by the presence, at thirty-nine feet, of a stratum of flint much better suited for implements than those above. The flint forming the floor of the shaft having been removed, galleries were driven in various directions to enable the workmen to extract more flint. These galleries averaged about three feet in height and from four to seven feet in width, and all the shafts were connected together by means of them. Numerous picks made from the antlers of Red Deer were found in the galleries.

At Cissbury the chalk is covered by but a few inches of soil. The shafts, though variable in size, resembled in character those of Grimes Graves, and were connected together by a network of similar galleries. Horn picks were

[3] Journ. Ethn. Soc., Jan., 1871. The pits are in the three-cornered wood half a mile N.E. of the words "Grimes Graves" on the Ord. Map (one inch). That examined by Canon Greenwell is still about twenty feet deep.

found, but they were not numerous.[4] The object there also was to work out a better flint-band than any nearer the surface. The depth of the shafts appears to have been about twenty to thirty feet.

We have thus in these two important ancient flint-working stations an essential identity of plan, purpose, and geological position. It is true that, as to this last point, we found thirteen feet of sand on the surface at Brandon, while only a few inches of soil covered the chalk at Cissbury. But in the thirteen feet of sand were many unworn flint nodules identical in character with those found elsewhere at the top of the chalk, and indicating by their presence the close proximity of that formation. At Cissbury there were signs that the pits had been used more or less for habitation, but the primary intention of the original excavators was undoubtedly to work out a particular flint-band. This is as evident as that the arrangements at a modern colliery are primarily adapted to the working out of a particular coal.

I now pass from these ancient flint-working stations to the equally remarkable artificial caves with vertical entrances, which are known as Deneholes, a word meaning *den*-holes. Strange to say, these pits, though mentioned by Camden, Lambarde, and Hasted, have received extremely little attention from the scientific observers of the present century, Mr. F. C. J. Spurrell being indeed the only person who deserves to be considered an authority upon them. And as Mr. Spurrell's first paper on the subject, of any importance, was read before the Archæological Institute so recently as April 7th, 1881, the result is that, while almost all geologists and anthropologists know more or less about Grimes Graves and Cissbury, the Deneholes of Bexley and Grays remain comparatively unknown. I may illustrate the neglect with which they have been treated by the following example. The late Dr. Buckland, the very eminent geologist, remarks, in his paper on the "Plastic Clay," written in 1817[5]:—"The

[4] "Additional Discoveries at Cissbury," by J. Park Harrison, M.A. Journ. Anthrop. Inst., May, 1878. Cissbury is 3½ miles N. of Worthing, Sussex. There is a model of the workings in the Pitt-Rivers Anthrop. Coll.

[5] Trans. Geol. Soc., vol. iv. (1817).

thick Woolwich sand occurs also at Bexley, where (as is the case in many of the woods about Dartford) shafts forty to fifty feet in depth have been sunk through it at an early period for the purpose of extracting the subjacent chalk, as is now done at Reading and Plumstead brick-kilns. Mr. Hasted, in his 'History of Kent,' conjectures that many of these quarries were excavated by the Saxons as places of retreat in times of danger. He states that some of them are twenty fathoms in depth, and that they are to be found also near Faversham, and at Fritwood, on the south of Murston Passage, near Milton. The explanation that is suggested by the geological position of all these places appears to be much more satisfactory."

We have seen that the shafts of Cissbury and Brandon were variable in size and shape, though usually of much greater diameter than those of Deneholes; were larger at the top than at the bottom, and were connected together by a network of low galleries from about three to five feet high, which followed the course of a particular flint-band. The Deneholes of Bexley or Grays have, on the contrary, shafts perfectly cylindrical in shape, of very small diameter,—two feet six inches to three feet, where they have suffered but little from the weather,—and the chambers at the bottom are lofty and symmetrical, from ten to thirty feet in height or thereabouts. There is no communication between adjacent shafts, though they are often as close together as those at Grimes Graves, and they do not appear to owe their shape to any desire to extract any particular band of flint. The shaft of a Denehole may be wholly in the chalk, or may be almost entirely in the Thanet sand and other overlying beds. It is obvious, however, that those Deneholes which differ from pits of the Grimes Graves class in geological position, as well as in structure, will most surely illustrate the primary intention of their makers.

No better examples could consequently be chosen for investigation than those which the Essex Field Club proposes to examine in Hangman's Wood; or those at Bexley, which correspond so closely to them in structure, and in

geological and geographical position. For while still deeper Deneholes once existed—there can be little doubt—in the neighbourhoods of Charlton Park and Blackheath, no shafts are now open in those localities, the former existence of Deneholes being only indicated by sudden subsidences such as that which we attempted to investigate last year at Blackheath. Want of funds obliged the Blackheath Subsidences Committee to close their investigation before the cause of these subsidences could be absolutely proved, but the evidence obtained convinced most of us, sooner or later, that the agency of Deneholes was—to say the least—the only one that would bear any close examination. A chief obstacle in the way of its acceptance was the fact that the excavators of a Denehole at Blackheath would have had the water-difficulty to contend with that caused the committee so much trouble and expense—a difficulty which it was thought very unlikely they would have been able to overcome. For at Blackheath, above the Thanet sand and below the Blackheath pebble-beds, lie about twenty feet of Woolwich beds, which include ten to twelve feet of clayey strata. These clays hold up the water which falls as rain on the pebble-beds at the surface, and would of course have formed a hindrance to the Denehole-makers not met with at Bexley or Grays. On the other hand, however, this water-difficulty was absolutely fatal to the opposite, or geological, theory of these subsidences. For it showed that the rain which falls on the surface of Blackheath never reaches the chalk at all, and consequently can have no action upon it. Besides, we were operating with a large shaft in previously shattered ground, whilst the Denehole-makers worked with a small shaft in unbroken ground. And as the water would be met with only in the two or three feet of sand or gravel immediately above the clayey shell-beds, it seemed probable that its percolation into the shaft might have been prevented by the simple application of clay to its sides in sufficient quantity in that small area.

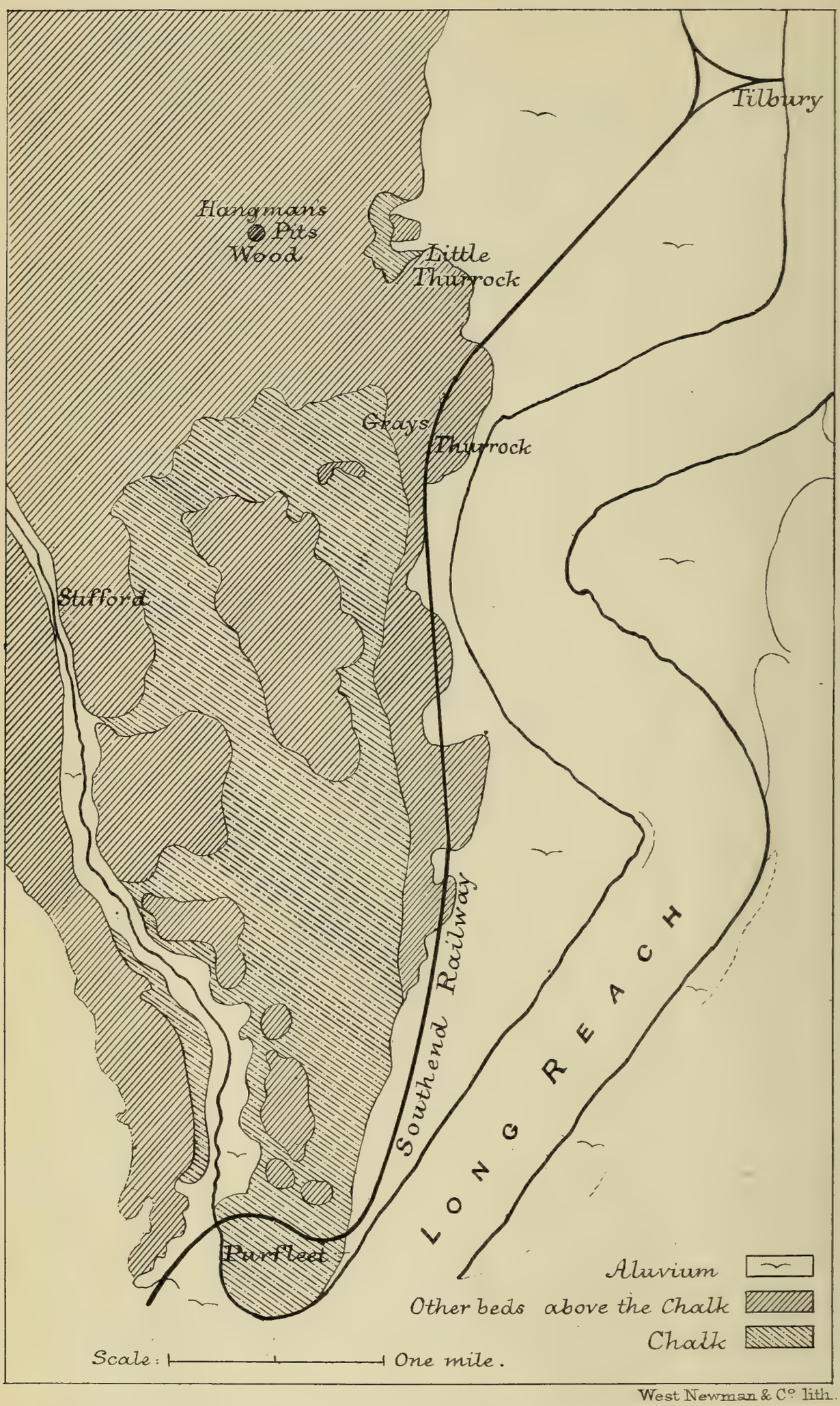
Before the publication of Mr. Spurrell's paper, the Blackheath Subsidences Committee was aware only of the existence

of the remarkable shaft and cavern in Eltham Park (as an example of what was originally in all probability a Denehole), in strata identical with those of Blackheath. It was accidentally discovered in 1878 by a workman, who, being sent down a disused drain, found himself at the top of a shaft which was afterwards determined to be 140 feet deep, and terminated in a chamber in the chalk, about 30 by 50 feet, and 9 to 9½ feet high. The shaft was lined with courses of brick and chalk, and was about 4 feet 1 inch in diameter. It is described by Mr. W. M. Flinders Petrie in the Proc. Roy. Archæol. Inst., March, 1878. In Mr. Spurrell's paper, however, will be found mention of evidence of the existence of Deneholes in Charlton Park and Kidbrook, where the strata are precisely the same as those of Blackheath. It may fairly be assumed that any Deneholes so deep, and comparatively difficult to make, as those of Blackheath, Charlton, and Eltham, must be of later date than those of Bexley and Grays.

At Bexley there is a remarkable concentration of Deneholes in two wooded spots, called Stankey and Cavey Spring, each of which is about equal in area to Hangman's Wood, the scene of our recent descents. The shafts are about equally close together, and their average depth is nearly the same in all three places. The strata sunk through are also identical, being either Thanet sand alone or Thanet sand with a slight capping of old river gravel. The surface of the ground at Cavey Spring and Stankey is slightly above, and at Hangman's Wood rather below, the 100 feet contour-line. The Deneholes in these three places were evidently the work of people with similar objects and similar ways of effecting them. In each case the excavators have chosen to sink through from forty to sixty feet of overlying beds before they penetrated the chalk, though in each case there is a broad expanse of bare chalk within a mile. Nor can this have occurred simply through geological ignorance, for if we suppose them so unobservant as not to have noticed the connection between flints at the surface and chalk below—a matter in which a savage would be especially acute—they

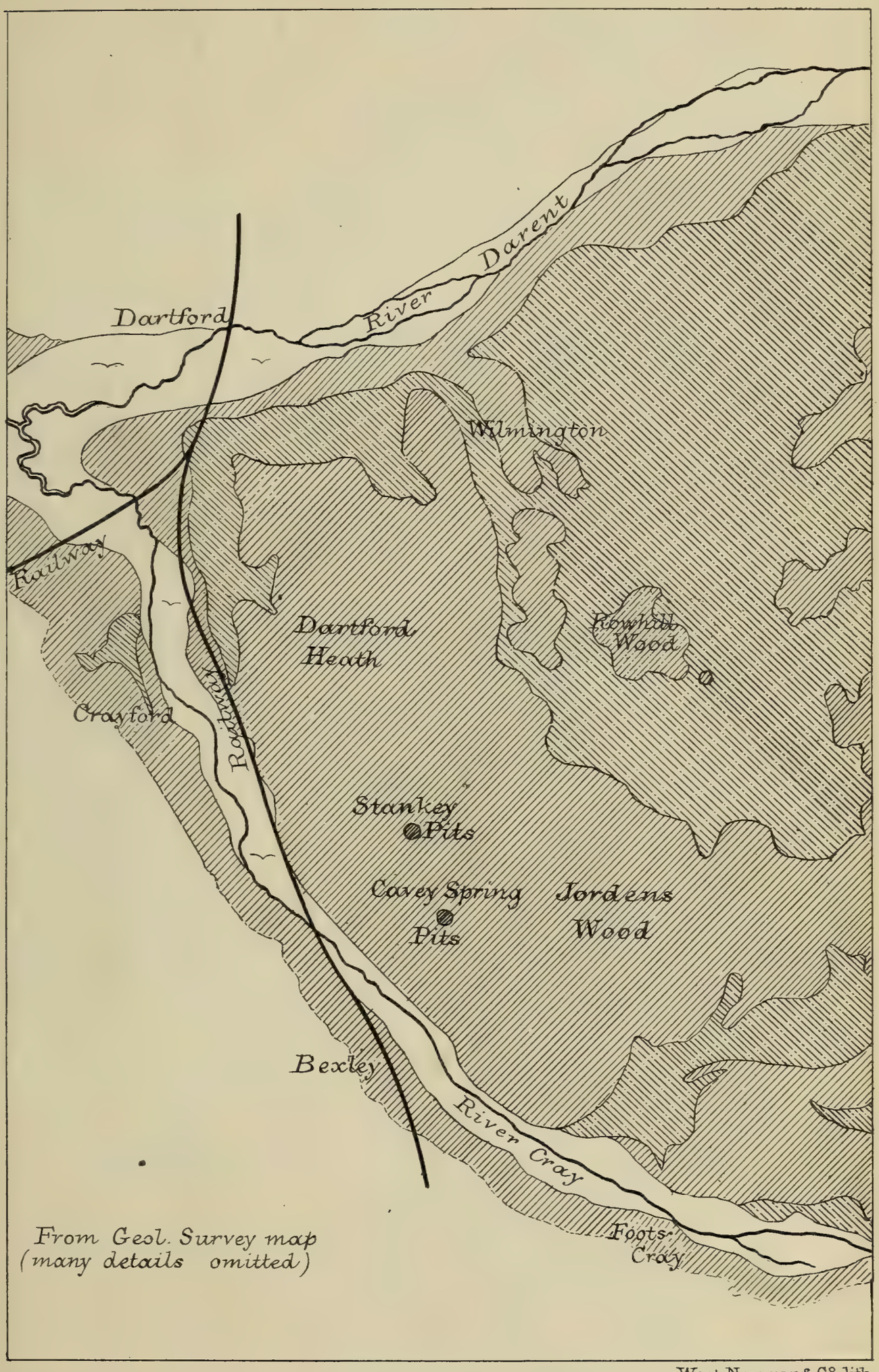
can hardly have been so abnormally perverse as to prefer—if wanting flint or chalk—to concentrate their excavations just where they got the least return for their labour. My maps (Plate I.) are taken from that of the Geological Survey showing the environs of London, and their object is simply to show the surface occupied by bare chalk as compared with that covered by the overlying beds. I have accordingly omitted all the subdivisions of the latter, the alluvial flats being alone separated on account of their value in illustrating the Physical Geography of these districts.

On Plate II. of Mr. Spurrell's paper are figured nine varieties of Deneholes, and it seems to me that Nos. 2, 3, and 4, which are all pits at Stankey, may be compared on terms of equality with the three we have already descended in Hangman's Wood. The three simple forms, Nos. 7, 8, and 9, are all shallow pits in the chalk only. So far, indeed, we have seen no pillars in the pits at Grays, while each of the Stankey pits figured has one or more. But this marks simply a later stage of development in the Stankey pits, not a different plan of excavation. No. 1 Pit, Hangman's Wood (Plate II.), may indeed have had at one time a general resemblance to No. 3 Stankey, and may owe the downfall of Thanet sand, which occupies so much of its space, partly to the thinness of its chalk roof (from one foot six inches to two feet) and partly to the removal of a pillar such as that still existing in No. 3 Stankey. But Nos. 2 and 3, Hangman's Wood, have evidently not reached the pillar stage. The greatest length in each pit is seventy feet, and is along a line passing through the centre of the shaft and of the openings opposite each other at its base, by means of which admission is given to the cavern. In No. 2, on one side of the shaft, are two chambers with a direction at right angles to the line of greatest length. On the opposite side of the shaft, however, there is a chamber on one side only, the sixth being entirely wanting. In No. 3 the sixth chamber is added, and the symmetry is complete. It would seem that there had been more demand for space in No. 3 Pit than in No. 2. For in No. 2 the chambers are very much narrower than in



West Newman & Co. lith.

Map to show the areas occupied respectively by Chalk and overlying beds near Grays, ESSEX.



West Newman & C° lith.

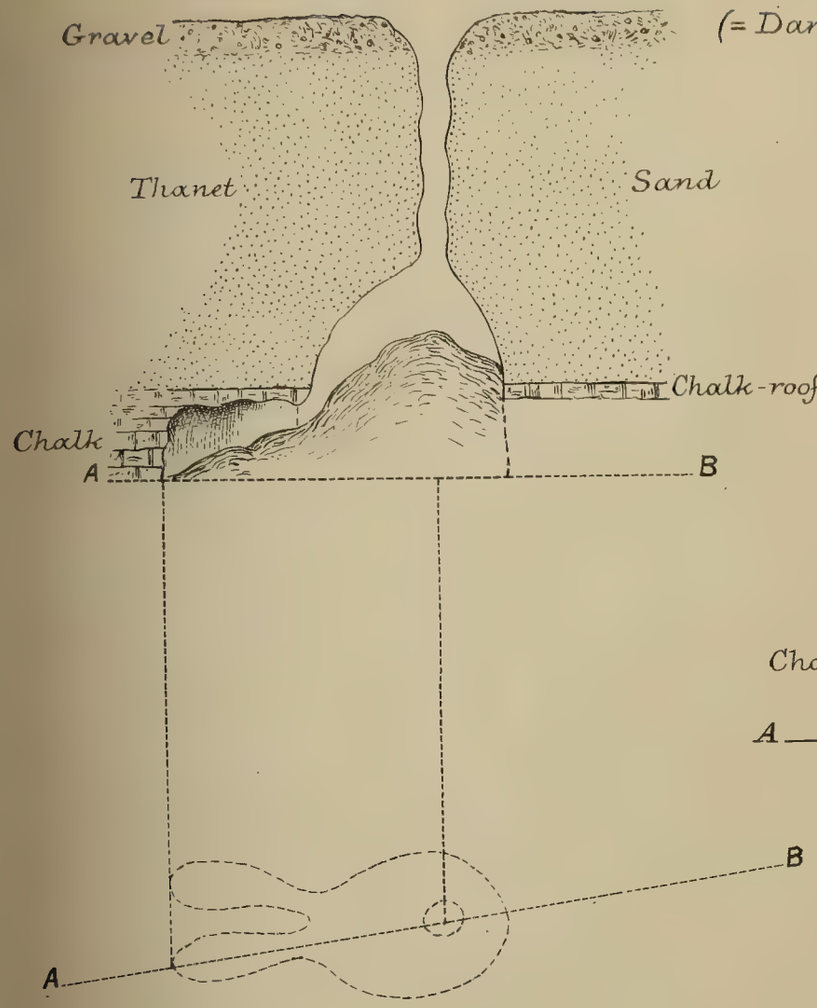
Map to show the areas occupied respectively by Chalk & overlying beds between Bexley and Dartford, KENT.

(Scale and shadings the same in both.)

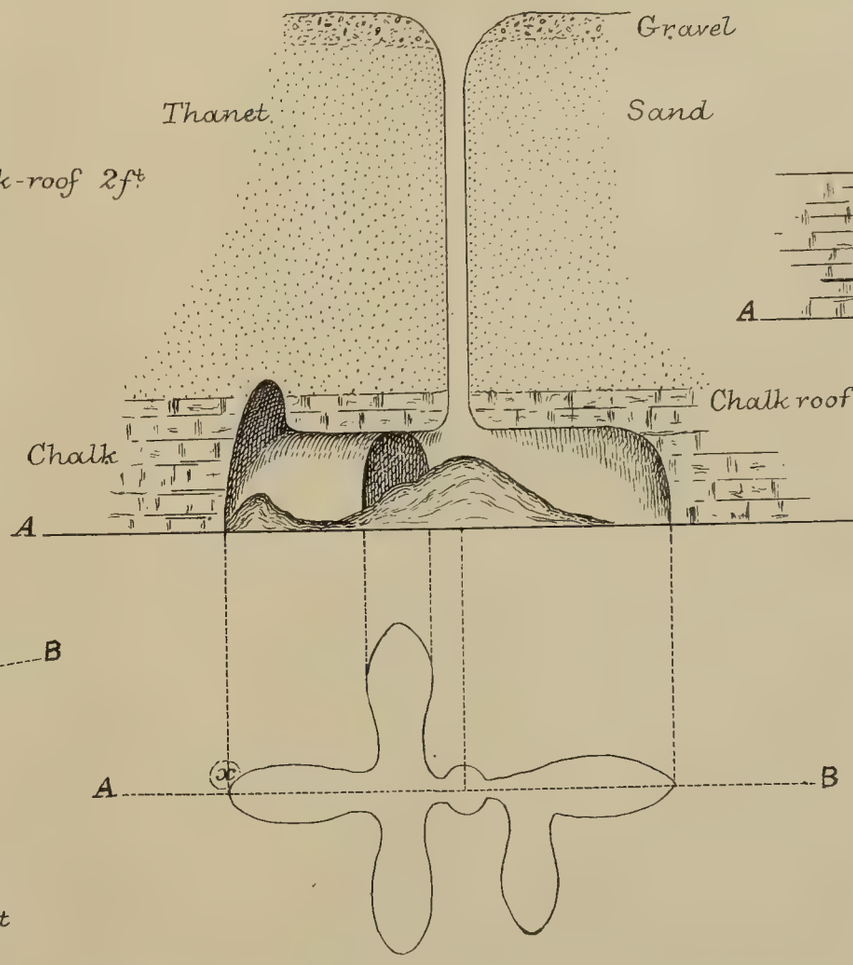
BRITISH
NATURAL HISTORY

HANGMAN'S WOOD.

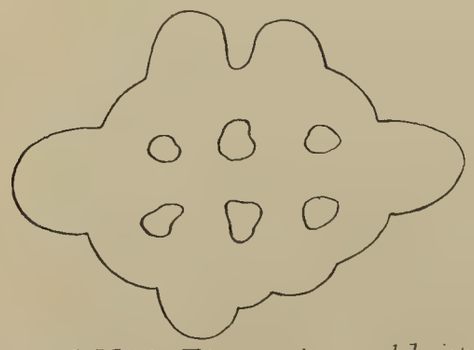
Nº 1. PIT.



Nº 2. PIT

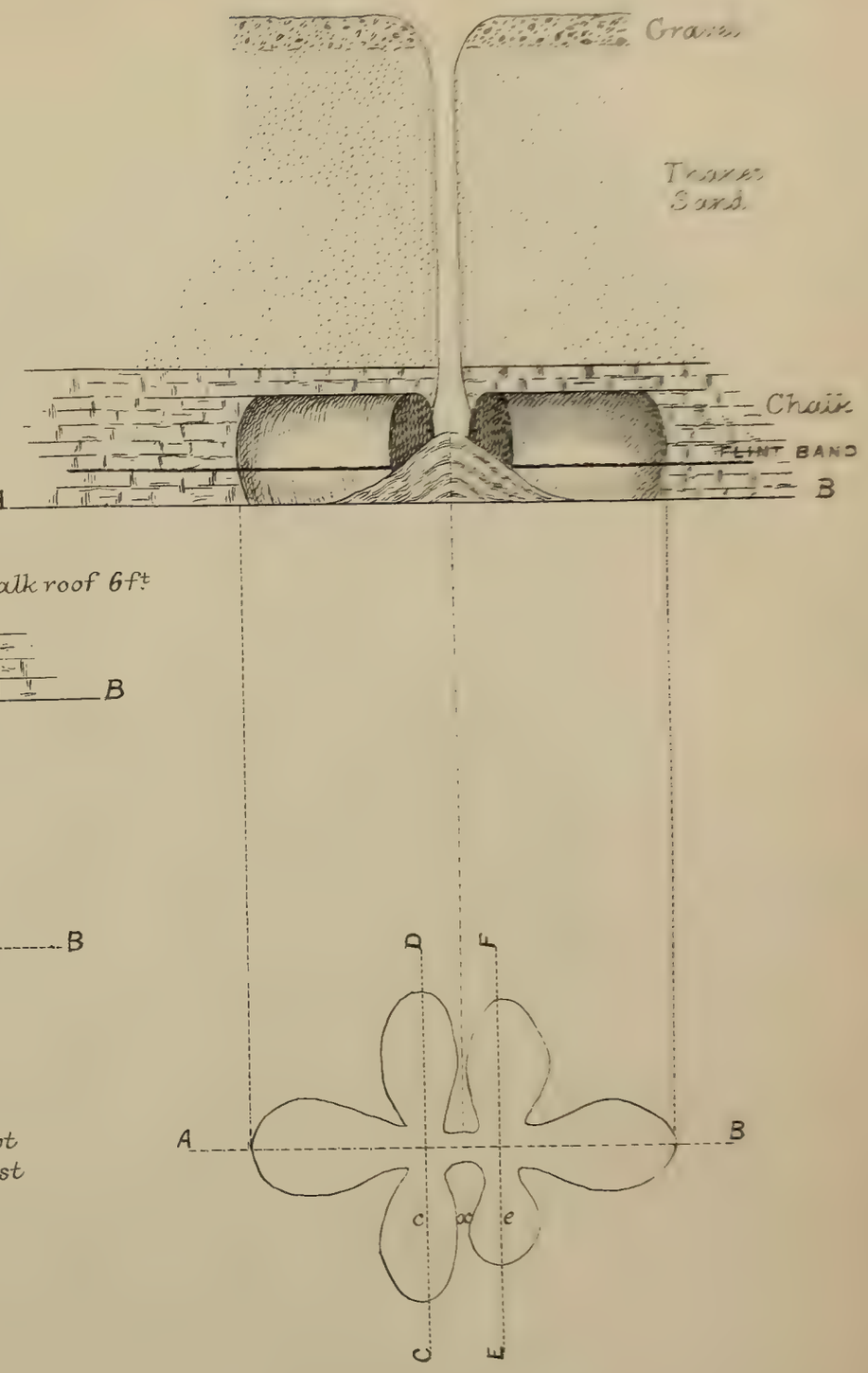


(x) I did not measure the hole (x) which does not seem part of the original design, and most likely is work of a later date.



Plan of Nº 3 Pit, as it would appear if further developed and the roof supported by six pillars.

Nº 3. PIT.

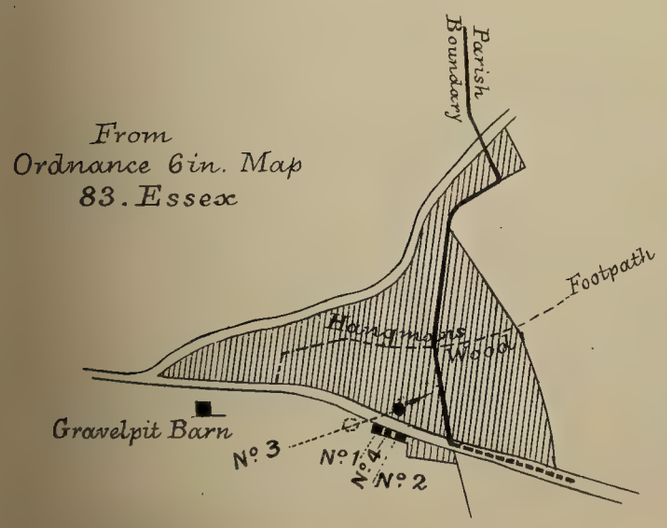


Height of Chamber 18 ft
Length along line A.B. 70 ft
" " " C.D. 52 ft
" " " E.F. 43 ft 6 in.
At x a hole through wall of Chambers c and e
Size about 2 ft square

Scale of Sections.

0 10 20 30 40 60 80 100 120 feet

40 feet to an Inch.



T.V. Holmes. delt.

No. 3, though their length is about the same. To give more space in No. 2 the excavators would naturally convert it into a likeness of No. 3, by adding a sixth chamber, and by increasing the breadth of all the chambers. But this increase of breadth would make the partitions between the chambers very thin, till at last a hole would appear in one of them, such as we saw in No. 3. Enlargement of this hole would give more space, and eventually produce a pillar on one side of the shaft. Soon a corresponding pillar would be similarly formed on the other side of the shaft. And by adding to the width of each chamber, without widening its mouth, the cavern would come, in time, to be supported by six pillars, each pillar standing in the space between what were once the mouths of the separate chambers. It would then assume the shape of No. 2 Pit, Stankey, as it was before the removal of the two pillars on one side of the shaft, which has caused so great a downfall from the roof. In No. 4 Stankey, we see a pillar formed on one side of the shaft, and another in process of formation on the other side.

In the case of pits the shafts of which are open, it must always be somewhat uncertain how much they have been modified since they ceased to be used for the purposes for which they were originally intended. I am inclined to think, myself, that either symmetry or a want of symmetry, which appears merely to mark a stage of the slow evolution I have endeavoured to trace, points towards the conclusion that pits in which they only appear have been altered, in no material degree, since they were used by the race that originally constructed them. Thus in Pit No. 2, Hangman's Wood, the only part that I should take to be of decidedly later date than the rest is the hole at one end of one of the two longest chambers, which is utterly out of harmony with what appears to be the original mode of development, and is in all likelihood the work of men to whom it was unfamiliar. Careful examination of the heap at the bottom even of an open shaft will, I trust, give some information as to its original date, while to drive a gallery from an open pit to an

adjacent unopened one—as suggested to me by our Secretary —would probably be the means of decisively settling the question of their age and use.

As the Charlton and Blackheath Deneholes must have been, judging from the greater difficulties attending their construction, of later date than those of Bexley and Grays, it may on similar grounds be considered probable that small and shallow pits in the chalk alone, such as Nos. 7, 8, and 9 in Mr. Spurrell's plate, are the oldest of all. Mr. Spurrell mentions one at Crayford, thirty-six feet six inches deep, which was examined. Part of the flint forming the floor had been taken up and piled in a heap on one side of the cave. The heap at the base of the shaft showed many flint flakes and scrapers; above these was primitive pottery, and above that Roman pottery. But though this primitive pit was thus shown to have originated in the Stone Ages, the age of the deeper ones still remains to be ascertained, and will, I trust, yield itself to the explorations of the Essex Field Club. And our investigations at Grays will have the advantage resulting from the fact that the primary purpose of pits solely in the chalk can never be so satisfactorily established as that of pits sunk through fifty or sixty feet of Thanet sand, where there is plenty of bare chalk within a mile. It seems probable that experience may have shown Thanet sand to be a better material for shafts than chalk. Mr. Spurrell describes some caves in the chalk near Rochester, and remarks:—"The shafts have been much enlarged by the action of frost, which detaches large blocks of chalk"—a serious consideration in the case of caves intended for permanent stores and refuges, though immaterial as regards temporary flint-workings.

That these Deneholes are very ancient—that they certainly date from a time when the art of building can scarcely be said to have existed in this island, and when invisibility formed the best security against the sudden attacks of an enemy—seems, to me, evident. And their position, as regards those at Bexley and Grays, at Blackheath and Charlton, points to the conclusion that the enemy feared

usually came along the one great highway, the Thames. But the banks of the Thames would, on the other hand, be a favoured resort of the native population, attracted both by the abundant supply of fish and the means of intercommunication. And a glance at a geological map will show that certain spots only, abutting on the river, make suitable sites for villages or towns. South of the Thames and east of London we have Greenwich, Woolwich, Erith, Greenhithe, and Gravesend, all places offering sites close to the river, and yet more or less above the level of the marshes. On the Essex side a broad spread of marsh-land borders the Thames between the outfall of the River Lea and Purfleet. At Purfleet and Grays, however, higher ground abuts on the stream, and approaches it more nearly than usual at East Tilbury and the neighbourhood of Mucking. Now, as regards Essex, Mr. Spurrell remarks that Deneholes are abundant between East Tilbury and Purfleet: and all the Essex examples mentioned by him are in the district between those places.

In Kent also we find the Deneholes especially abundant near the old settlements, or sites for settlements, on the river, at Greenwich, Woolwich, Erith, and Greenhithe. And in all these cases, both in Kent and Essex, the position of the Deneholes, one, two, or three miles from the river, and their concentration in spots about the same distance from the natural sites for settlements on the Thames, seem to suggest that they were used both as storehouses and as places of occasional refuge from pirates who might attack the villages on the river-bank. This seems to me the only natural presumption in accordance with, and favoured by, the evidence afforded by the plan and situation of the Deneholes themselves. And when, in addition, we review the store of facts collected by Mr. Spurrell, showing the past and present prevalence of underground granaries and dwellings in all parts of the world, civilized and uncivilized, the fact dawns upon us that caves for these purposes have accompanied a certain stage of social progress, almost everywhere, while those subserving other ends have been local and

exceptional. We are fortunate in this part of England in the great breadth of chalk at or near the surface, which has peculiarly favoured not only their construction, but their preservation, for the information of ourselves in this present age.

Note on Plate II.—The shaft "No. 4," shown on the Map of Hangman's Wood, has not been yet described (Oct., 1882). It is numbered in order to show which pits have already been visited, the three shafts, Nos. 1, 2, and 4, being very close together.

IV.

THE PRESIDENTIAL ADDRESS; DELIVERED BY RAPHAEL MELDOLA, F.R.A.S., F.C.S., &c., AT THE ANNUAL MEETING, JANUARY 27TH, 1883.

LADIES AND GENTLEMEN,

THREE years have now run their course since the foundation of the Essex Field Club, and in taking a survey of that interval we may fairly lay claim to a success which has exceeded the most sanguine expectations of those who brought our Society into existence. In vacating this chair, which by your forbearance I have had the honour of occupying from the period of our inauguration, I may state that my own connection with the Club will be amongst the most pleasant reminiscences of my past life. It gives me great satisfaction to know that you have elected as my successor a gentleman whose interest in your well-being will not be less warm than my own, and under his guidance I have no doubt you will continue to occupy that high position which you have won among the local societies of this country.

The business matters laid before you in the Council Report require but little comment on my part. On retiring from the office of President I may, however, perhaps be permitted to offer a few non-official suggestions, which I tender with the more confidence as having been closely associated with the executive body of the Club from the period of our foundation. First with regard to our publications, I feel it necessary to dwell shortly upon this the most important part of our labours. I have on previous occasions taken it upon myself to urge upon the Council the necessity for giving publicity to the many excellent papers read at our meetings as soon as conveniently possible after the reading of the papers. If we need any convincing proof of our prosperity it is to be found in the list of communications the publication

of which we have been obliged to defer from last year. In the early days of our existence we experienced the usual difficulties of young societies—I refer to the difficulties of getting scientific support. Happily that complaint is a thing of the past, and with our increasing numbers there has come a steady influx of substantial contributions to our 'Transactions.' From the day of our foundation I have maintained, and I still maintain, that the larger portion of the Club's income should be spent, and indeed cannot be better spent, than in the judicious publication of such papers as come legitimately within our province. By this means alone can we hope to keep up our position as a county Club, since our distant members would receive but little in return for their subscriptions did they not have in a permanent form an account of our doings at head-quarters. But the question with which I have to deal is fortunately not one of to publish or not to publish, but simply how much we can afford to publish in the course of a year. During the past year we have found, in fact, that our very moderate rate of subscription has not sufficed to enable us to keep pace with the publication of papers as they were contributed; and we have therefore been compelled, as the only means of controlling our expenditure, to delay the issue of another part of the 'Transactions' till the present year. Part 7 is only now going through the press, and will shortly be distributed among our members. Were this delay forced upon us merely by virtue of our income being insufficient to meet our requirements we should have but little to reproach ourselves with, and indeed we might fairly congratulate ourselves upon having such a wealth of material to draw upon. But unfortunately much of our difficulty has arisen from a tardiness on the part of many of our members to discharge their obligation to the Club at the commencement of the year, when the subscriptions become due.

There is another consideration also which must be borne in mind in this connection. In these days of rapid progress in science many papers lose in interest by delay in publication, and authors whose contributions we most value may thus be

compelled to publish through other channels, to the serious detriment of our 'Transactions.' Whether we shall in future find that our scientific contributions are always in excess of our available income cannot be with certainty foreseen. If, however, our numbers continue to increase as steadily as they have during the last three years, and if, moreover, we give force to certain rules of economy which we have considered in Council, I venture to think that before long we shall bring about the necessary equilibration between income and expenditure without pushing our publications into the background. Under any circumstances it is most desirable to be able to clear off our present list of papers, and at the same time to be in a position to meet future emergencies. Seeing how liberally we have been supported on former occasions, in all appeals to our members in aid of special investigations, I have considerable hesitation in suggesting the raising of another fund; and will content myself by merely hinting that all those who have the Club's interests in view can aid in this matter by giving a small annual donation in addition to their ordinary subscription. It is only the strong feeling which I possess with regard to the importance to the future welfare of the Society, of publishing well and frequently, that has induced me to speak out my mind on this point; and I am encouraged in this by the circumstance that the proposal has already met with a ready response on the part of many members to whom the matter has been broached, several having volunteered to double their subscriptions in order to further the work of publication. The advantage which would accrue to all our members by an increase in the size of our volume of 'Transactions' is too obvious to require insisting upon here.

It is with great pleasure that I am able to announce several handsome donations towards the expenses connected with the forthcoming part of the 'Transactions.' From Mr. T. C. Baring, M.P., we have received a cheque for £10; Mr. T. V. Holmes has generously offered to defray the cost of two large plates to illustrate his paper on "Deneholes"; Mr. Worthington Smith has also undertaken to illustrate his

own paper on "Primeval Man in the Valley of the Lea" gratuitously. The value of this last offer will be appreciated when I state that the author has prepared over twenty woodcuts for us. To Mr. Daw we are indebted for a woodcut of the beautiful neolithic flint chisel or gouge exhibited by Mr. N. F. Robarts at a former meeting; Mr. Charles Thomas has presented us with two woodcuts representing his new live-trough for the microscope; and Mr. Arthur Lister has offered to defray the cost of the figures necessary to illustrate his note on *Vaucheria*, read at our Chigwell Meeting.

At the Southampton Meeting of the British Association, held last August, I had the pleasure, together with our member Mr. John Spiller, of representing the Essex Field Club at the Conference of Delegates. As the outcome of this Conference a Committee was appointed, consisting of Mr. J. Hopkinson, Mr. H. G. Fordham, and myself, for making arrangements for the next Conference, to be held during the Meeting of the British Association at Southport in 1883. Of course the subjects to be dealt with by such a Conference can only be of a very general nature, since it is impossible that the work of local societies can be regulated or that any special course of investigation can be dictated by the Conference. The number of general subjects open to all local societies is very limited, and Mr. Hopkinson has already drawn up and circulated some excellent tables for the use of those societies which make meteorological and phenological observations a part of their regular work. One other branch of work to be done by local societies and field clubs has suggested itself to me, and I shall hope to be able to make some remarks upon this subject at the next Conference. I venture to think that every local society, or at least two or three of the societies of each county, should undertake the cataloguing of the local prehistoric remains in their neighbourhood. I might even go so far as to suggest that the systematic investigation of such remains is work proper to all county societies; but at any rate, as a preliminary step, we should have a complete list of the ancient remains of each county, and this is a subject which might very profitably

occupy the attention of local science clubs at a time when we are beginning to realise the great loss which the science of Anthropology has sustained by the ignorant and wilful demolition of many venerable relics of past ages. Happily, under Sir John Lubbock's Act, the ancient monuments of this country will come under the protection of the Government; but while the larger and more generally known remains are thus insured against destruction, the smaller and more obscure earth-works, tumuli, cromlechs, &c., which are in their way of equal importance, might escape such protective influence unless special attention was directed to their existence. Local catalogues such as I have suggested would thus be of great use in this scheme of protection, and would greatly facilitate the work of the Government Inspector, our Honorary Member General Pitt-Rivers, to whom I have already broached these ideas and who has expressed his warm approval of them.

With regard to the publications of local societies, I am glad to see that the Council of the British Association has appointed a Committee "in order to draw up suggestions upon methods of more systematic observation and plans of operation for local societies, together with a more uniform mode of publication of the results of their work." This Committee is composed of Mr. H. G. Fordham (Secretary), Mr. Francis Galton, Mr. John Hopkinson, Mr. W. Whitaker, Mr. G. J. Symons, Sir Walter Elliot, Prof. W. J. Sollas, Mr. A. Ramsay, Mr. C. E. De Rance, the Rev. Dr. Crosskey, and myself.

The duty of presenting the Preliminary Report on the results of our excavations at the Loughton Camp devolved upon me at the Southampton Meeting of the British Association; and our Committee was reappointed, as you are aware, with the addition of Mr. Worthington Smith, and a grant of £10 towards our expenses. Four sections have now been made through the rampart of this earth-work, and a considerable number of relics have been found on the old surface-line. These relics consist of numerous flint flakes in remarkably fresh condition, a partially-finished flint celt,

and several fragments of rude pottery. The survey of the Camp and its surroundings will, I trust, be shortly completed, so that the final report may be presented at the next meeting of the Association at Southport. It is very satisfactory to know that our labours in the two Forest Camps have been so far crowned with success that we have for ever dispelled the traditions which connected these remains with the Romans. Other excavations will have to be made at some future time in Ambresbury Banks, and I hope that the Essex Field Club will not let slip this opportunity of extending our knowledge of this interesting object of local prehistoric Archæology. In the meantime, however, another problem in the same field of science has presented itself, and the systematic exploration of the "Deneholes" at Grays will be the next task which we propose to take in hand. Although no subscription-list has yet been formally opened, funds for this purpose are already beginning to come in, and it is anticipated that early this summer we shall have sufficient in hand to warrant a preliminary examination of some of these imperfectly-known prehistoric human workings.

The obituary list for the year includes the name of Mr. George T. Saul, F.Z.S., of Bow, to whose loss I briefly alluded on a previous occasion (see page i, 'Proceedings').

Darwin and Modern Evolution.

Our list of honorary members suffers, as I had the sad duty of announcing at a former meeting, by the removal of the universally-revered name of Charles Darwin, who breathed his last on April 19th, 1882, at his residence, Down, Kent, in the seventy-fourth year of his age. Much has already been said and written about Mr. Darwin, and I cannot hope to give you on the present occasion anything beyond a general sketch of the enormous services rendered to every branch of natural science by this greatest of philosophic naturalists during a life of active work extending over more than half a century. Darwin was born at Shrewsbury in 1809, and on the side of both his parents came of celebrated lineage. He was grandson to Erasmus Darwin, the poet-naturalist, and

his mother was a daughter of Josiah Wedgwood, the renowned Etrurian potter. Darwin's scientific career may be considered to have commenced by his appointment as naturalist to H.M. Surveying Ship 'Beagle,' under Captain, afterwards Admiral, Fitzroy. The 'Beagle' left England in 1831, and was absent for nearly five years. Soon after his return Darwin settled at Down, and from that time his life—a most uneventful one from a biographical point of view—was mainly devoted to those researches which have resulted in nothing less than a complete revolution in our conceptions of organic nature.

Such ample notices of Darwin's works appeared in the various newspapers at the time of his death that it is quite unnecessary for me to do more than to name them, pending the appearance of the complete biography which all are anxiously awaiting. Omitting the shorter papers contributed to the publications of the learned societies, the following is the list of works in the order of publication :—

1842. 'The Structure and Distribution of Coral Reefs.' 2nd ed., 1874.

1844. 'Geological Observations on the Volcanic Islands and Parts of South America visited during the Voyage of H.M.S. "Beagle."' 2nd ed., 1877.

1845. 'A Naturalist's Voyage round the World.' New ed., 1860.

1851–1854. 'A Monograph of the Cirripedia.' 2 vols. (Ray Society).

1851. 'A Monograph of the Fossil Lepadidæ or Pedunculated Cirripeds of Great Britain.' (Palæontographical Society.)

1854. 'A Monograph of the Fossil Balanidæ and Verrucidæ of Great Britain.' (Palæontographical Society.)

1859. 'The Origin of Species by means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.' 6th ed., 1872.

1862. 'On the Various Contrivances by which British and Foreign Orchids are fertilised by Insects.' 2nd ed., 1877.

1868. 'The Variation of Animals and Plants under Domestication.' 2nd ed., 1876.

1871. 'The Descent of Man, and Selection in Relation to Sex.' 2nd ed., 1874.

1872. 'The Expression of the Emotions in Man and Animals.'
1875. 'The Movements and Habits of Climbing Plants.' 2nd ed. (A re-publication, with additions, of a memoir published in the 'Journal of the Linnean Society' for 1865.)
1875. 'Insectivorous Plants.'
1876. 'The Effects of Cross- and Self-Fertilisation in the Vegetable Kingdom.'
1877. 'The Different Forms of Flowers on Plants of the same Species.' (A reprint, with additions, of a series of papers published in the 'Journal of the Linnean Society' in the years 1862, 1863, 1864, and 1868.)
1880. 'The Power of Movement in Plants.' In conjunction with Francis Darwin.
1880. 'The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits.'

Such is the legacy bequeathed by Charles Darwin to the science of the nineteenth century! The mere list of works above catalogued gives no adequate idea to those unacquainted with their contents of the marvellous powers of observation, the fertility of resource, the great experimental skill, the inexhaustible patience over the minutest details, or the grand faculty of generalisation possessed by this master worker. For years to come he has left materials for thought and work to the school of younger naturalists that has grown up under his inspiration.

Whilst bearing our humble share of the loss which the whole civilised world has sustained, we have the satisfaction of knowing that Darwin was personally interested in our success. It will be remembered that he was among the first to give us his support at the time of our inauguration, and on subsequent occasions he showed an active appreciation of our labours. The last expression of encouragement which I received from him was in a letter dated August 8th, 1881, wherein he wrote, "I am glad to see how extremely flourishing your Essex Club appears to be." We can with the greater reason lay claim to a direct sympathy in Darwin's work, for he was himself in the strictest sense a field-naturalist as

distinguished from a museum-naturalist. It was during the five years' cruise of the 'Beagle,' of which the personal narrative was given to the world in his celebrated 'Naturalist's Voyage,' that the future philosopher was first led to ponder over those phenomena of living nature with which he was brought into contact, and which, as he tells us in the 'Origin of Species,' induced him on his return to speculate on the great problem indicated in the title of that work. When in later life he continued his studies in this country, it was always *living animals and plants* that were appealed to when possible; his most important experiments and observations were made upon materials growing in his greenhouse or garden, or were collected from the surrounding country; and in his broader generalisations, which necessitated a wider survey of facts, he always made use of the observations of those to whom Nature had spoken face to face. Even when failing health compelled him to abandon the great literary undertakings which were promised to supplement the 'Origin of Species,' he delighted in minute observation as a recreation.[1] To his friend and co-worker, Mr. A. R. Wallace, he once remarked:—"When I am obliged to give up observation and experiment, I shall die." Nature was to Darwin a living, organically-connected whole; with him science did not begin and end with the accumulation of series of dried and labelled specimens.

In spite of all that has been written for and against the Darwinian theory, it is surprising how much this doctrine is still misunderstood by the general public. Ask any non-scientific person what he imagines to be conveyed by the word "Darwinism," and he will probably tell you that it is the theory that man is descended from a monkey, which is about as explicit as saying that the Newtonian theory of gravitation is something to do with an apple. Indeed I may

[1] The difficulties besetting the experimental investigator are forcibly recalled to my mind by a remark once made to me by Mr. Darwin. Speaking on this subject I said that Nature, when thus questioned, often gives an evasive answer, to which he replied, "She will tell you a direct lie if she can."

venture to say that there are many extreme specialists, even within the pale of science, who have but a vague idea of the extremely important influence which this hypothesis has upon their studies. On such an occasion as the present, when, after recording our deep sense of gratitude to the man who so nobly dedicated his life to the advancement of knowledge, it becomes my duty to direct your attention to his works, I think that I cannot do better than occupy your time by recapitulating the main points in the theory of the origin of species.

Starting with the simple calculation showing the rate of increase of any species as deduced from the number of young produced at a birth, and comparing this with the actual number of individuals at present existing, we find that an immensely greater number of young must be produced than ever survive. Thus, in the case of the elephant, which "is reckoned the slowest breeder of all known animals," it is seen that a single pair, supposing their offspring to survive and to breed at the rate of six during a lifetime of a century, would in the course of 740 to 750 years have given rise to nearly nineteen million elephants living at the end of that period.[2] Similarly with birds, if we allow that one pair produce four young ones per annum and breed but four times during their life, in fifteen years this pair will have increased to more than two thousand millions.[3] Some instructive data have been quite recently given by Mr. P. L. Simmonds[4] with reference to the rabbit in Australia and New Zealand, where this animal has become a perfect pest within a period of twenty years since its first introduction. "From New Zealand alone eight and a half millions of rabbit-skins were exported in 1880, but this does not probably represent one-tenth part of those actually destroyed. In that climate the rabbit breeds nearly every month in the year. But even supposing that a pair of rabbits do not breed

[2] 'Origin of Species,' 6th ed., p. 51.

[3] A. R. Wallace's 'Contributions to the Theory of Natural Selection,' p. 29.

[4] Journ. Soc. Arts, Dec. 22nd, 1882, p. 99.

oftener than in England, which is seven times a year, and that they only bring forth eight young at a time, they would multiply in the course of four years to a million and a quarter."

Granting this fact, that all organisms tend to increase at a geometrical rate, it is clear that every species must have in itself the potentiality of unlimited extension, and must constantly be endeavouring to extend itself at the expense of others; every species must be waiting to fill any vacancy in the polity of Nature; there must be a perpetual competition going on—a continual "struggle for existence," which keeps in check the undue increase of any particular species. Thus the animals and plants of any region are in a state of nicely balanced equilibrium, the result of long ages of adjustment to their surroundings both organic and inorganic. "In looking at Nature, it is most necessary to keep the foregoing considerations always in mind—never to forget that every single organic being may be said to be striving to the utmost to increase in numbers; that each lives by a struggle at some period of its life; that heavy destruction inevitably falls either on the young or old, during each generation or at recurrent intervals. Lighten any check, mitigate the destruction ever so little, and the number of the species will almost instantaneously increase to any amount." [5]

The science of Geology teaches us that the face of Nature is undergoing slow but constant change, so that the inorganic environment of species is by no means immutable; and since geological changes must entail rearrangement of life, the organic environment is similarly in a state of fluctuation. The equilibrium between a species and its environment is thus subject in the course of time to be disturbed; new conditions of life gradually come on, the region inhabited becomes more or less extended, climatic changes may supervene, the amount of atmospheric moisture and the annual rainfall may increase or diminish, the mean annual temperature may become higher or lower, new competing forms or other foes may extend their range into the area—in short,

[5] 'Origin of Species,' 6th ed., pp. 52—53.

the equilibrium between the species and its environment has to be readjusted or extinction would follow. Now Darwin has shown that there is no compromise in this readjustment between Nature and her children—her motto is, "change or die." The adaptations of species to their life-conditions are only effected by a process of transformation, the raw material for such modification being furnished by the slight variability which is natural to every organism. All naturalists know what is meant by variability. The individuals of any species are not all absolutely alike as though cast in one mould, but present differences in all or in certain characters, the nature and amount of the difference depending upon the particular species; in some cases the aberration is great and conspicuous, but such "sports" are not considered by Darwin as having played any important part in the modification of specific forms. The offspring of any animal or plant thus differ more or less from their parents and from one another; the aphorism that "like produces like" is true only with a certain latitude, and those fluctuations of form which interfered so seriously with the "plan of creation" of the older naturalists furnish the means by which living beings can become adapted to new conditions of existence.

A geometrical ratio of increase leading to a struggle for life, individual variability, and incessant change of external conditions being admitted facts, the next question is, how does the organism become adapted to changed conditions of life?—how is the equilibrium between a species and its environment maintained? In answer to this, Darwin appeals to domesticated animals and plants, and shows how races are modified by artificial selection, how by selective breeding the various animals and plants kept by man have been apparently moulded to man's use by the long-continued selection and accumulation of those slight variations which the breeder has learnt to distinguish. Substitute for the art of the breeder the struggle for life, and we have a motive power competent to restore the equilibrium between an organic form and a changed environment. Instead of artificial selection by man, we have a process of "natural selection"; the

rigorous necessity of coping with new conditions is met by a call upon the variational resources of the species, those individuals which are best adapted to the new requirements surviving and leaving offspring which inherit the advantageous qualities, whilst the less favoured individuals succumb in the struggle. The process has been happily termed by Herbert Spencer, "the survival of the fittest." In this way a species becomes gradually transformed, or, when occupying an extended area, may give rise to two or more species; and since Nature's operations are seldom conducted by cataclysms, the changes in external conditions come on slowly, the adaptation being perfected from generation to generation by the continuous selection of the fittest—by the summing up of all the advantageous variations through inheritance. Making use of a mechanical simile, we may say that the individual constituents of the species move in the direction of least resistance towards the position of new equilibrium.

The struggle for life is necessarily the more severe the more nearly alike are the competing organisms, because the nearer the relationship between the latter the more closely do they agree in their requirements—the greater is the similarity in their structure, habits, and constitution. "We may assume that the modified descendants of any one species will succeed so much the better as they become more diversified in structure, and are thus enabled to encroach on places occupied by other beings."[6] Now survival of the fittest involves the extinction of the unfitted, and as diversity gives the greater chance of success to the larger number of organisms, there is a tendency for variational extremes to survive at the expense of the less divergent varieties—a tendency for species to break up into heterogeneous forms through "divergence of character."

Such in broad outline is the theory of Natural Selection advanced by Darwin to account for the origin of species, and it has now become a part of the scientific history of our time that very similar, if not identical, views were put forward by

[6] 'Origin of Species,' 6th ed., p. 90.

Mr. A. R. Wallace—whose name, I am happy to see, still graces our list of Honorary Members—in the year 1858. Having had the privilege of personal acquaintance with the late Mr. Darwin, and still enjoying the friendship of Mr. Wallace, I cannot resist the pleasure of once more detailing the history of the birth of this theory, since this history conveys a lesson in scientific etiquette well worthy of those from whom the doctrine emanated. Having been struck during the voyage of the 'Beagle' by many facts in the distribution of animals and plants which seemed to throw light on the origin of species, on his return to this country Darwin in 1837 began to collect materials, and for five years went on "accumulating and reflecting on all sorts of facts" that appeared to have any bearing on the problem. After this period, as he tells us, he allowed himself to speculate, and had formulated his conclusions in 1844, but not with a view to immediate publication. In 1858, *twenty-one years after he had first taken the question seriously in hand*, he had nearly completed his task, although he then foresaw that many more years' work would be necessary in order to fully elaborate his views. It is to the fortunate circumstance that Mr. Wallace had independently arrived at similar conclusions that we are indebted for the accelerated publication of the 'Origin of Species' in 1859. Mr. Wallace, who, after spending some years in Tropical America with Mr. Bates, had gone to the Malay Archipelago to study nature in the Old World tropics, sent from Sarawak in 1855 his first contribution to the theory of descent. In this paper, which appeared in the 'Annals and Magazine of Natural History' for September, 1855, under the title of "The Law which has regulated the Introduction of new Species," Mr. Wallace shows by various lines of argument that "every species has come into existence coincident both in time and space with a pre-existing closely allied species." In 1858 Mr. Wallace sent from Ternate another paper, "On the tendency of Varieties to depart indefinitely from the Original Type," which embodied the theory of Natural Selection. This paper was sent to Mr. Darwin, who showed it to his friends, Dr.

Hooker and Sir Charles Lyell, by the latter of whom it was communicated to the Linnean Society, and was published in the 'Proceedings' for August, 1858.[7] At the same meeting of the Society Mr. Darwin gave an outline of his theory, and his paper appeared at the same time as Wallace's. The slight sketch published by Darwin in 1858 was elaborated the following year into his epoch-making work on the 'Origin of Species,' the first edition of which was published on November 24th, 1859. On learning that Darwin had for more than twenty years been accumulating facts which had led him to the same conclusions, Wallace with the greatest generosity relinquished his claim in favour of his great compeer.[8] In these days, when we hear of petty squabbles about the "priority" of claim for having attached a label to some new insect, the following remarks from the Preface to Wallace's 'Contributions to the Theory of Natural Selection' (1870) read with refreshing magnanimity:—"The present work will, I venture to think, prove that I both saw at the time the value and scope of the law which I had discovered, and have since been able to apply it to some purpose in a few original lines of investigation. But here my claims cease. I have felt all my life, and I still feel, the most sincere satisfaction that Mr. Darwin had been at work long before me, and that it was not left for me to attempt to write the 'Origin of Species.' I have long since measured my own strength, and know well that it would be quite unequal to that task. Far abler men than myself may confess that they have not that untiring patience in accumulating, and that wonderful skill in using large masses of facts of the most varied kind,—that wide and accurate physiological knowledge,—that acuteness in devising and skill in carrying out experiments,—and that admirable style of composition, at once clear, persuasive, and judicial,—

[7] Mr. Wallace has narrated to me that one of his correspondents, a well known entomologist, wrote to say that it was a general remark in natural history circles, with respect to this paper, that it was much to be regretted that the author had not more confined himself to statements of fact!

[8] Lyell states that Darwin was also "willing to waive his claim to priority." 'Principles of Geology,' 12th ed., vol. ii., p. 278.

qualities which in their harmonious combination mark out Mr. Darwin as the man, perhaps of all men now living, best fitted for the great work he has undertaken and accomplished."

I have thus far dealt only with the 'Origin of Species' because, of Darwin's literary productions, this is doubtless the one which has had the greatest influence upon contemporary thought. It must be remembered that this work was considered by its author to be a mere abstract of the vast body of evidence and the enormous array of facts which he had collected, and he promised to expand the various chapters into future volumes. The 'Variation of Animals and Plants under Domestication' was the fulfilment of this promise with respect to the first chapter of the 'Origin.' The storm raised by the publication of the latter book, both within and without the ranks of science, will be long remembered by those who were contemporaneous with this first truly scientific attack upon the older doctrine of the special creation of species by miraculous agency. It is somewhat difficult for those who, like ourselves, have, so to speak, been brought up in the school of evolution to realise the state of mind of pre-Darwinian naturalists with respect to this question of species. The supposed authority of ancient tradition had, without doubt, stultified all enquiry in this direction, and workers intent only upon recording and describing had fallen into a state of intellectual torpor as regards that philosophical stimulus so vital to progress in all departments of natural knowledge. Occasional attempts had certainly been made to overthrow the current belief in the immutability of species, but these had not produced any permanent effect. It was Darwin's 'Origin of Species' that first caused a rattling among the dry bones of the venerable dogmas that had so long usurped the place of scientific thought; with the appearance of this work superstition was driven from its last stronghold in the realm of natural science.

If, as some writers assert, virulence of attack is a criterion of the truth of a new doctrine, the 'Origin of Species' certainly came into the world under very favourable auspices.

It would indeed be a most interesting study in psychological evolution to compare some of the earliest with some of the later opinions on the Darwinian theory. This is a task which I commend to those who have time and opportunity for collecting materials for such a comparison. Now, in the peace following the strife, it seems perhaps a reversion to ancestral savagery to execute a war-dance over the prostrate bodies of the slain; but, for my own part, acknowledging that, as a youth, I fell into the ranks of Darwinism, I cannot but own that a recent perusal of some of these early attacks has afforded me considerable satisfaction. Looked at in the present state of knowledge it is seen that many of these criticisms were prompted by nothing else than the animus of bigotry, or were the ignorant vituperation of extreme specialism; nor is it, perhaps, necessary to say that some of the loudest clamour was raised by those having no shadow of a claim of any kind to make themselves heard. Of these multifarious expressions of opinion the majority were, it is needless to state, devoid of value, and in many cases the critics, perhaps from an incapacity for handling the true weapons of scientific discussion, descended to personal aspersions upon Mr. Darwin's character. But, on the other hand, the views advanced were more ably handled by the larger-minded and more competent thinkers in the world of science. From these appeared some criticisms of real importance, which led Darwin, with that splendid candour which was part of his nature, to modify certain details of his theory in the later editions of the 'Origin.'

In the meantime, in the quiet seclusion of his Kentish home, Darwin pursued his labours with "philosophic calm," answering his critics with gentleness, and turning a deaf ear to personalities, knowing that he had a great truth to proclaim to the world, and upheld by the knowledge that the leaders of biological science had become his disciples. In this country Sir Charles Lyell, the illustrious founder of Uniformitarian Geology, Dr. Hooker, Herbert Spencer, Prof. Huxley, and Sir John Lubbock, were among the first to give the weight of their support to the Darwinian hypothesis;

Prof. Huxley, indeed, became so zealous a champion that he diverted on to his own head some of the vials of wrath that had been prepared for Mr. Darwin, and by his able exposition of the doctrine of development contributed to no small extent in securing its firm establishment in our country.[9] But while the battle for truth was going on here, on the Continent, and more especially in Germany, the new doctrines were received and discussed with even greater warmth and enthusiam. A school of the most able naturalists rallied round the Darwinian standard, their zeal often carrying them beyond the bounds of that prudence and caution displayed by their leader. More than once, as Darwin told me on one occasion, has he had to privately chide his too zealous adherents. Foremost amongst those who have taken the greatest part in promulgating and contributing to Darwinism in Germany stands the name of Prof. Ernst Haeckel, of Jena; and work of the highest order of importance has been contributed also by Prof. Carl Vogt, Moritz Wagner, Prof. August Weismann, G. Th. Fechner, the brothers Fritz and Hermann Müller, Prof. Oscar Schmidt, and others; whilst from the philosophical side the theory has been most ably expounded by Frederick Albert Lange.[10]

The rapid spread of the Darwinian theory among those most competent to form a true estimate of its value soon made itself felt in the field of biological literature, and many works of lasting importance to scientific knowledge appeared as living witnesses to the vitality of the doctrine. Specialists in every department of biology contributed materials, and indeed many workers on the Continent became specialists with the express object of testing the vitality of the views advanced in the 'Origin of Species.' "From the hour of its

[9] The advocacy of those who—like Prof. Tyndall, W. (now Sir William) R. Grove, and the late lamented Prof. W. K. Clifford—spoke from the ranks of physical rather than of natural science, did great service in promoting the cause of evolution among the wider circles of the general public.

[10] 'Geschichte des Materialismus,' 3rd ed., 1877, vol. ii. Eng. Translation by E. Chester Thomas, vol. iii., 1881, chap. iv.

appearance," says Lyell,[11] "it gave, as Professor Huxley truly said, 'a new direction to biological speculation,' for even where it failed to make proselytes, it gave a shock to old and time-honoured opinions, from which they have never since recovered. It effected this not merely by the manner in which it explained how new races and species might be formed by Natural Selection, but also by showing that, if we assume the principle, much light is thrown on many very distinct and otherwise unconnected classes of phenomena, both in the present condition and past history of the organic world." In the year 1869, at a meeting of the German "Naturforscher Versammlung," a society analogous to our British Association, Prof. Helmholtz—of world-wide fame as mathematician, physicist, chemist, and physiologist—in his opening address at Innsbrück, in reviewing the doctrine of Natural Selection, said, "Darwin's theory contains an essentially new creative thought,"[12] a dictum which is all the more weighty as coming from one who has himself obtained such a many-sided and profound insight into Nature's laws.

But tempting as is this theme, time compels me to refrain from any further reference to contemporary scientific opinions on the Darwinian theory. It will suffice to say, in the words of its illustrious author,—"Now things are wholly changed, and almost every naturalist admits the great principle of evolution."[13] On the very last occasion that I had the pleasure of an interview with Mr. Darwin, he said that he looked upon the 'Origin' as a book of the past; it had done its work, and might now be shelved. But here, as in many other cases, his inborn modesty led him to undervalue his own work, and I feel confident that I express the views of every worker in biology when I say that for many years hence the 'Origin of Species' will be at hand as a repository of carefully digested facts, and a storehouse of suggestions for future work.

Now the theory of species established by Darwin is

[11] 'Principles of Geology,' 12th ed., vol. ii., pp. 281, 282.

[12] 'Popular Scientific Lectures,' 1873, p. 385.

[13] 'Origin,' 6th ed., p. 424.

based, as previously stated, upon certain indisputable facts, viz., the high rate of multiplication of living beings, the struggle for existence, change of environment, and the principle of heredity. Every species is, on this view, genetically descended from some previously existing species; and since the changes of external conditions take place on the whole with extreme slowness, the process of modification must have proceeded with corresponding slowness. It is of the utmost importance to bear in mind that, in admitting the Darwinian theory, we for ever exclude the possibility of any "innate tendency" to change in species; the modification of living forms is mainly brought about by external factors, and we cannot regard a species as a production endowed with a predisposition to grow into some other form by virtue of an internal law of growth making itself manifest only with the lapse of time. As long as the external conditions remain unchanged the species remains fixed. Paraphrasing Newton's first law of motion, we might say that a species perseveres in its existing state unless acted upon by external forces. Whether the modification of species has always proceeded at the same rate is perhaps an open question, but considering the vicissitudes both astronomical and geological through which our earth has passed, and supposing that life appeared as soon as permitted by the temperature of the globe cooling down from a molten condition, it seems to me that change, both geological and organic, may have taken place at a greater rate in past ages than at the present time, in which case the slow present rate of transformation may be no absolute measure of the past rate of modification, and the large demands upon time made by many supporters of the descent theory may permit of being more or less curtailed.

The classification of animals and plants into species, genera, orders, classes, &c., according to their "affinities," now, as in pre-Darwinian times, continues to occupy the attention of large numbers of our working naturalists, but in the light of the theory of descent it is seen that this arrangement into groups within groups is no less than an attempt to

reconstruct genealogies from the surviving remnants of past faunas and floras. For the term "affinity" we may now substitute the expression, blood-relationship. Thus, taking any group of allied forms, such as the species of a genus, we say that these have descended from a common ancestral form now extinct. The wider the group which we are considering the further back in time should we have to go to arrive at the point from which the various forms composing the group diverged; in other words, the degree of difference between species is a measure of the amount of their divergence from a common parent. The science of Palæontology, which deals with the life of the past as preserved to us in fossil remains, becomes linked by inseparable bonds to Taxonomy. It is to the geological record that we have to appeal to fill up those links which are necessary for the completion of our pedigrees. How vastly increased in importance becomes the determination of true morphological affinity—with what surpassing interest does Homology become endowed—when we know that the structural resemblance of two animals, however externally disguised, is due to community of descent from an ancestor that lived in the remote ages of geological antiquity.

Until the publication of the 'Origin of Species' geologists had never fully realised the fact that their fossil collections represented but an infinitesimal fraction of the whole number of animals and plants that had peopled the earth from the earliest times. Darwin says on this point:—"I look at the geological record as a history of the world imperfectly kept, and written in a changing dialect; of this history we possess the last volume alone, relating only to two or three countries. Of this volume, only here and there a short chapter has been preserved; and of each page, only here and there a few lines."[14] "The crust of the earth, with its imbedded remains, must not be looked at as a well-filled museum, but as a poor collection made at hazard and at rare intervals."[15] When, from the standpoint of modern Geology, we consider how small is the chance of the preservation of an animal or plant in the state favourable for fossilization, and when we

[14] 'Origin,' 6th ed., p. 289. [15] Ibid., p. 427.

further reflect upon the vicissitudes to which fossiliferous strata are and have been at all times exposed by denudation, erosion, and metamorphism, it appears to me that there is not much matter for marvel in this poverty of the geological record, but rather that we should wonder at its comparative richness. In fact the geological record, however imperfect it may be, has furnished the very strongest evidence in favour of the Darwinian theory, and since the year 1859 the progress of Palæontology has enabled many gaps between the most diverse groups of animals to be filled up. What more distinct in external form and mode of life than birds and reptiles? These two classes had, however, long been known to anatomists to be structurally related, and on the principle of evolution the existence of intermediate forms might have been anticipated. In 1862, after Darwin had predicted the existence of such connecting links,[16] there was found in the Solenhofen limestone of the Upper Jurassic series, in Bavaria, the now well-known *Archæopteryx*, an animal uniting the characters both of birds and reptiles. Professor Huxley subsequently pointed out that a family of extinct gigantic reptiles, the *Dinosauria* of the Oolite and Cretaceous formations, presented certain distinctly avian characters. These discoveries culminated, in 1875, in Professor Marsh's great find of toothed birds, the *Odontornithes* of the Cretaceous beds of Kansas,[17] a discovery which, as Professor Huxley says, "removed Mr. Darwin's proposition that 'many animal forms of life have been utterly lost, through which the early progenitors of birds were formerly connected with the early progenitors of the other vertebrate classes,' from the region of hypothesis to that of demonstrable fact."[18] In a similar manner the pedigree of the horse has been traced back by Professor Marsh to the Eocene species of *Eohippus*,[19] an animal about the size of a fox; and the pedigrees of the

[16] 'Origin,' 1st ed., p. 431.

[17] Vol. i., 'Memoirs of Peabody Museum of Yale College'; vol. vii., "Geological Exploration of the 40th Parallel."

[18] "The Coming of Age of the 'Origin of Species,'" 'Nature,' May 6th, 1880, p. 3.

[19] Amer. Jour. Sci., 1879.

Camels and Hyænas have been worked out by Professor Cope[20] and M. Gaudry[21] respectively. In Palæontology, as in every other branch of Biology, the Darwinian theory has in fact become incorporated as a part of common knowledge; witness the following extracts from the latest text-book of Geology published in this country:—"It must be conceded that on the whole the testimony of the rocks is in favour of the doctrine of evolution."[22] "But to the palæontologist it is a matter of the utmost importance to feel assured that, though he may never be able to trace the missing links in the chain of being, the chain has been unbroken and persistent from the beginning of geological time."[23] "From this point of view the investigations of Palæontological Geology are invested with the profoundest interest, for they bring before us the history of that living creation of which we form a part."[24]

Returning once again to the principles of the selection theory, we see that every modification of an organism implies the addition to, or the modification of, some structure or function already possessed. It is most essential to bear in mind that Darwin's prime mover, natural selection, acts not only upon external characters, but likewise upon internal organisation; minute constitutional or physiological deviations at present utterly beyond the ken of science, can be seized upon and perpetuated by this agency when of any advantage to the possessor. The survival of the fittest is utilitarianism *in excelsis*. From the dawn of life upon this earth there must thus have been on the whole a tendency for living beings to increase in complexity of structure and function,—a tendency to a more complete biological division of labour both in individuals and in races,—a tendency to become more and more specialised, or, as it is said, to "advance in organisation." It is almost needless for me to pause here in order to point

[20] Amer. Nat., 1880.
[21] 'Les enchainements du Monde Animal.'
[22] Geikie, p. 624.
[23] Ibid., p. 626.
[24] Ibid., p. 627.

out how completely the facts of Palæontology accord with this view. But although it is thus permissible to speak of the Darwinian theory as a theory of evolution, it must not be forgotten that evolution is not necessarily Darwinism. It is the more necessary to remember this in order to fully realise the vast change in thought wrought by Darwin. Long before the appearance of the 'Origin of Species' there had been evolutionists. In 1809 Jean Lamarck published his 'Philosophie Zoologique'; in 1828 Geoffroy St. Hilare declared his belief in evolution; the author of the 'Vestiges of Creation' (1844) was an evolutionist; many others, and among them Göethe, the Shakespeare of German literature, had expressed the doctrine of evolution before Darwin; but it was our own great countryman who convinced the world of its truth. The bare facts of morphology, of classification, and of geological succession, are *suggestive* of evolution, but it required a Darwin to point out how evolution had taken place in organic nature.

The causes of transmutation of species assigned by the older evolutionists were in fact inadequate. For Lamarck these causes were mainly habit and the direct action of external conditions; the author of the 'Vestiges' found the causes of evolution in "impulses" implanted in living beings, tending to adapt them to their surroundings, and causing them to rise in the scale of organisation. It was reserved for Darwin to clothe the skeleton hypothesis of evolution with the flesh and blood that converted it into a living theory. To my mind, no more convincing proof of the force of Darwin's reasoning is to be found than in the conversion of Sir Charles Lyell, for the whole spirit of this great geologist's teaching was in every essential evolutionary; and yet he had rejected the Lamarckian hypothesis in the early editions of his 'Principles,' wherein he had advanced long and elaborate arguments showing the insufficiency of the French naturalist's theory. But in the thirteen years' interval that elapsed between the publication of the ninth and tenth editions of the 'Principles of Geology,' the author's opinions on this question had undergone a change; and in the latter

edition, as also in his 'Antiquity of Man,' he not only gave a masterly exposition of the Darwinian theory, but added considerably to its weight, and enforced its acceptance by several new and striking lines of argument.

It would lead me too far astray on this occasion were I to attempt to go in any detail over the various lines of evidence converging upon the central idea of evolution. It suffices to say that many large groups of biological facts that had before appeared isolated and inexplicable were not only in the strictest scientific sense explained, but "as by the stroke of the enchanter's wand" the various great subdivisions of Biology fell into, and became part of, Darwin's scheme of Nature. "Every ray is gathered into one focus, and the rich development of theory guides the apparently most remote phenomena of organic life into the stream of proof."[25] Let us consider, for instance, the generalised facts of Embryology. The development of an organism from the first germ to the mature state is essentially a process of evolution. The researches of embryologists, beginning with the illustrious Karl Ernst von Baer, and ending alas! in recent times with the lamented Francis Maitland Balfour, have shown that in the course of its individual development an animal passes through stages which approximate it at first to the lowest types, and then in succession to types of increasing specialisation. The individual in fact "rises in organisation" in the same sense as does the species. Specialisation increases with development, till finally the adult animal acquires all the characters of the species to which it belongs. How are such facts intelligible if we reject the theory of descent? The researches of Darwin upon the laws of inheritance have shown that all characters tend to be transmitted by parents to their offspring at the same age or a little earlier than they appear in the parents. This is Haeckel's law of "homochronic heredity." The embryonic phases of an organism are thus reminiscences of its past development—recapitulations of the stages through which its ancestors passed in the course of their evolution. The individual development or

[25] Lange, *l. c.*, vol. iii., p. 31.

ontogeny, as Haeckel expresses it, is the racial development or phylogeny *in nuce*. At a certain stage of its development the human embryo, for example, has gill-slits and branching arteries as in fishes, and at later stages it is tailed and hairy. What do such facts mean, if they are not revelations that man's ancestors have passed through an aquatic stage, and later through that of a tailed hairy mammal? From the Darwinian standpoint the parallelism between embryos and fossil remains, so recently pointed out by Professor Agassiz, is not a mystery, but a necessity; and the science of Embryology becomes linked on the one hand to Taxonomy, and on the other to Palæontology.

In a similar manner the geographical distribution of animals and plants, the relations of the faunas and floras of islands to those of the mainland, and the relation of existing to extinct faunas and floras of the same area, all become explicable by the aid of the descent theory, and are meaningless on any other hypothesis. But time presses, and I will only pause here to point out the somewhat interesting circumstance that the facts of this nature, which first led Darwin to speculate on the origin of species, have been left for their complete co-ordination and generalisation to the contemporary founder of modern evolution, Mr. A. R. Wallace, whose works on the 'Geographical Distribution of Animals' and 'Island Life' may be regarded as the completion of the twelfth and thirteenth chapters of the 'Origin of Species.'

Of other classes of facts explained by the principle of evolution I need only mention the existence of rudimentary organs, which are, on this view, the surviving remnants of structures that were useful to the organism at some former period of its existence. The next classes of cases to which I will allude are those of "persistent types," and of retrograde development or "degeneration." It must be remembered that Darwin's theory does not postulate, as is so frequently assumed, the continual *advancement* of every living creature. Transformation only takes place when stimulated by the action of the environment. Under certain conditions, where by isolation or by constancy in the external conditions of life

the species is protected from Nature's strife, it may persist unaltered or with only slight modification throughout whole geological periods, as we see in the numerous low forms of aquatic life, and higher in the scale in such types as *Lepidosiren* and *Ornithorhynchus*, which Darwin speaks of as "living fossils."[26] Or again, through parasitism or other causes, a species may be driven to a mode of life in which high organisation is not only useless, but may be actually detrimental to its possessor. In such cases natural selection, having only the good of the species in view, would bring about a more lowly-organised condition in the adult animal, while the younger stages, by the law of homochronic heredity, would retain the higher structure of the ancestral form. This principle of "degeneration" is seen in such groups as the Ascidians, the parent-stock of all the vertebrate animals; in the barnacles, which are degenerate Crustacea; and in the Mexican Axolotl. The development of Darwinism in this direction will be found in works by Anton Dohrn[27] and Prof. E. Ray Lankester.[28]

Before concluding this necessarily imperfect sketch of Darwin's chief work, there remain a few considerations to which I should like to direct attention. I may remind you, with reference to the various objections that have from time to time been urged against the theory of selection, that there has not been a more candid critic of this theory than Mr. Darwin himself, and in point of fact it is not going too far to say that hardly any difficulty of importance has been raised which was not suggested in the 'Origin of Species.' I will, with your permission, dwell briefly upon one or two objections which are still occasionally to be heard.

Variability, the basic factor of species-transformation, is

[26] Just as this Address was completed there appeared in 'Nature' an interesting article by Prof. Hubrecht, in which the subject of persistent forms of life is treated in a somewhat novel way, under the title of "The Hypothesis of Accelerated Development by Primogeniture, and its place in the Theory of Evolution." Vol. xxvii., pp. 279 and 301.

[27] 'Der Ursprung der Wirbelthiere und das Princip des Functionswechsels,' Leipzig, 1875.

[28] 'Degeneration, a Chapter in Darwinism,' Macmillan, 1880.

sometimes spoken of as taking place in every direction; that is to say, it is supposed that every species presents an infinite number of variations for natural selection to act upon. Thus it may be fairly asked, why under these circumstances extinction should ever take place? If variability is infinite, why should there not be a capability on the part of any species to meet any contingency—to become modified in any direction? In reply to this question, it may be stated that the range of variability required by Darwin's theory, although wide, is not and cannot be unlimited. There are restraining forces within the organism. The force of heredity, by which the latter tends to retain not only the characters of its immediate parents, but likewise those of more remote ancestors, determines the physical constitution of the organism, and checks unlimited variability. The delicate balance of internal forces constituting the physiological equilibrium of the organism cannot admit of being displaced in every conceivable direction—there can be only a certain range of variability possible to each species. An organism may be compared to a bell, which, although capable of vibrating in a very great number of ways and of giving out a great number of notes according to the way in which it is struck, nevertheless cannot be made to give out an infinite number of notes, because its molecules are constrained to vibrate in certain definite ways only by virtue of its physical construction. In every case of species-transformation there are thus involved two factors, "the nature of the organism, and the nature of the conditions."[29] It is to Professor Weismann that we owe the first full recognition of the important part played by the organism itself in the process of evolution, but it must be borne in mind that the part thus played is *quoad* modification, a purely passive one.

In connection with the foregoing considerations, there arise the questions of the causes of variability and the extent to which the latter takes place in particular species. It is very much to be regretted that Darwin was compelled by failing health to abandon his intention of discussing the subject of

[29] 'Origin,' 6th ed., p. 6.

'Variation under Nature,' in a work which was promised to follow his 'Variation of Animals and Plants under Domestication'; but it is well known that his system never completely rallied from the effects of the voyage of the 'Beagle,' and his work, herculean though it may be in the eyes of his contemporaries, becomes greatly enhanced in wonder when we consider that for years he laboured bravely under the most distressing physical disadvantages. But although the great task remains uncompleted in its details, much light was thrown upon this important subject by Darwin in his other works, and it has since been discussed in many able treatises emanating from the German school of Darwinians. With respect to the extent and origin of variability, I cannot do better than refer you to a very valuable paper by Mr. A. R. Wallace, in the 'Nineteenth Century' for January, 1880. This question of the origin of variability, however important on other grounds, is in fact of secondary consideration as far as concerns the Darwinian theory proper. Ten years ago[30] I cited a certain class of cases in illustration of the fact that natural selection acts upon such variations as arise, with entire disregard to the *causes* of these variations. When, indeed, we look upon an individual organism, as we now must, as a being in which is epitomised the hereditary tendencies of a long chain of ancestors which have at various periods been exposed to the most diverse conditions, I cannot but agree with those who maintain that the problem should be inverted, and that it is not variability but constancy which demands an explanation. "Does any one ask for a reason why no two gravel-stones or beach-pebbles, or even grains of sand, are absolutely identical in size, shape, surface, colour, and composition? When we trace back the complete series of causes and forces that have led to the production of these objects, do we not see that their absolute identity would be more remarkable than their diversity? So, when we consider how infinitely more complex have been the forces that have produced each individual animal or plant, and when we know that no two animals can possibly have

[30] Proc. Zool. Soc., 1873, pp. 153—162.

been subject to identical conditions throughout the entire course of their development, we see that perfect identity in the result would be opposed to everything we know of natural agencies. But variation is merely *the absence of identity*, and therefore requires no further explanation; neither do the diverse amounts of variation, for they correspond to the countless diversities of conditions to which animals have been exposed, either during their own development or that of their ancestors."[31]

It would be doing an injustice to the memory of Charles Darwin were I to leave upon your minds the impression that he regarded natural selection as the sole cause of species transformation. In the 'Origin' certain other important factors, such as the direct action of external conditions, use and disuse, compensation and economy of growth, correlated variability, &c., are discussed at some length. The principle of sexual selection—by which the difference in colour, ornamentation, weapons, &c., of such frequent occurrence between the sexes throughout the animal kingdom, is explained on the view that either the male or female in each species has throughout a long series of generations selected variations having these characteristics—was also laid down in the 'Origin,' and afterwards elaborated in great detail in the 'Descent of Man,' the main portion of this work being devoted to the establishing of this principle. But after giving due weight to these auxiliary factors the chief share in the work of modification is still assigned to natural selection, although the candid avowal is made that there may be other unknown processes in operation. The truly philosophical side of Darwin's character is perhaps nowhere better shown than in the admission that he had not explained everything—that his system was not to be taken as final. He has not given us a complete theory of things in the sense of ancient scholasticism, which for the bread of knowledge substituted a stone that stood as a stumbling-block in the way of further advancement. Darwin has demonstrated a *vera causa* of organic evolution, but he has done even more

[31] A. R. Wallace, 'Nineteenth Century,' Jan., 1880, p. 105.

in bequeathing to us the true spirit of inquiry into Nature's laws by legitimate method. The lustre shed by our Honorary Member upon the present age will not wax and wane with the fluctuations of opinion as to the efficiency of the "survival of the fittest," but his influence will be felt throughout generations of posterity by virtue of that plasticity of mind which he conferred upon his contemporaries, compelling them to reconsider old doctrines, and ultimately effecting a complete revulsion in thought. In a Society such as this, comprising as it does many young and aspiring naturalists, it is perhaps the more necessary to insist upon this moral conveyed by Darwin's teachings. It is true that there are some eminent men of science who, although evolutionists, do not admit the sufficiency of the Darwinian factors; but at the same time they could not deny that their acceptance of evolution in any form is entirely the result of Darwin's influence. The discovery of the theory of selection was a very great contribution to science, but the establishment of the principle of evolution was a still greater contribution to philosophy.

The question as to how far evolution can be legitimately admitted to have taken place in the organic world is by some considered to be open to discussion. It cannot be denied that the proof that natural selection is competent to modify *species* does not necessarily carry with it the proof that groups of great dissimilarity, such, for example, as the vertebrates and the molluscs, have sprung from a common stock. But those who admit evolution in principle need feel no distrust on this head, even if Palæontology has not as yet supplied the transitional links. In cases of this kind, however, arguments of another order come in, and homology, embryology, &c., may be appealed to for completing the evidence that is wanting to bridge over the gaps in the chain of being. On this point Darwin is very explicit:—"Throughout whole classes various structures are formed on the same pattern, and at a very early age the embryos closely resemble each other. Therefore I cannot doubt that the theory of descent with modification embraces all the members of the same

great class or kingdom. I believe that animals are descended from at most only four or five progenitors, and plants from an equal or lesser number." [32] Carrying on the argument by analogy, which, as he cautions us, "may be a deceitful guide," he then shows that there is no well-defined distinction between the lowest animals and the lowest plants. "Therefore, on the principle of natural selection with divergence of character, it does not seem incredible that, from such low and intermediate forms, both animals and plants may have been developed; and, if we admit this, we must likewise admit that all the organic beings which have ever lived on this earth may be descended from some one primordial form. But this inference is chiefly grounded on analogy, and it is immaterial whether or not it be accepted." [33]

If I may venture to push Darwin's analogy still further, it appears to my mind that we can hardly stop even at the "primordial form." If continuity is a great law of Nature we cannot logically admit of any break between the organic and the inorganic worlds, and although, as I wish most strongly to emphasise, there is no *necessary* connection between Darwin's teachings and a belief in so-called "spontaneous generation," it seems to me that if we accept evolution in its broadest meaning we are compelled to admit, with Lamarck and Haeckel, that at former periods, or possibly even at the present time, the very lowest beginnings of life have been or are being evolved by the operation of natural causes. For fear of misrepresentation let me here add that there is at present not a vestige of *scientific proof* countenacing such a belief. The reasoning of the consistent evolutionist in this matter is of precisely the same kind, only different in degree, as that which he employs when stating his belief that the gap between two widely divergent animals or plants, which at present appear isolated and distinct, is simply caused by the present imperfect state of palæontological or embryological knowledge concerning them.

Much as I could have wished to have given you some idea

[32] 'Origin,' 6th ed., p. 424. [33] Ibid., p. 425.

of the scope of Darwin's other works, this is quite beyond the bounds of possibility on the present occasion.[34] The 'Variation of Animals and Plants under Domestication,' the 'Descent of Man,' and the 'Expression of the Emotions,' contain the direct applications of the theory of descent to particular groups of phenomena, and the conclusions arrived at in some of his other books have a certain bearing on this doctrine. The magnitude of his labours can be best estimated by striking out from the list which I have given all those works which are directly related to the 'Origin of Species,' and there will even then remain a body of researches which by themselves would be sufficient to have established for Darwin the reputation of being the most active and able observer of our time.

Of the personal character of Darwin, everything that can be said by those who knew him has already been expressed, and it is impossible to add anything to the weight of their testimony. By his intimate acquaintances he was venerated, by friend and foe he was alike respected. In conversation, which in later life his health prohibited him from maintaining for any length of time, his manner was vivacious and often humorous, his features lighting up with expression and shedding a genial warmth upon his listeners. When speaking on subjects that lay beyond the sphere of his own studies he would ask for and receive information with the most profound attention, as though endeavouring to find some bond of connection between facts that were new to him and the already vast store of knowledge upon which he was always able to draw in illustration of his own remarks. He was simplicity personified, and the pretentiousness of professorial dignity was quite foreign to his disposition. He liked to be received in the character of the country squire rather than as the author of the 'Origin of Species.' I remember how

[34] An excellent account of Darwin's scientific work appears in the current (January) number of the 'Century,' from the pen of Mr. Wallace. Those who wish to acquire a concise and sound idea of the doctrine of evolution cannot do better than consult Mr. Romanes' little work in 'Nature' Series, Macmillan & Co., 1882.

with keen enjoyment he once related to me some of his early experiences among the pigeon-fanciers, into which select circle he desired to gain admission when studying the variation of our domesticated productions. The motion having been put to the meeting and carried, "Squire Darwin" was elected, but could not be admitted before payment of the subscription. The money was handed in, and the chairman of the club, even then apparently doubtful of the trustworthiness of the candidate, proceeded to test the coin by the usual methods before formally announcing his election.

Among the many noble qualities which endeared Darwin to his friends was his ever ready sympathy for the younger men that looked up to him as their master. There are many at the present time rising into prominence who will carry with them to the grave the memory of the impetus given to their career by the kindly encouragement, the assistance and advice, so freely given by Darwin. How many will echo the sentiment expressed by an eminent German naturalist who, writing to me soon after Darwin's death, said :—"The loss of Darwin is certainly for nobody more irreparable than for me, for I have lived so completely isolated, and for long years have been accustomed to communicate to him all my little scientific results, always certain of his full participation and sympathy."

Such was the life which, terminating last April, has left a void in the ranks of science that we can never hope to see filled up. The great doctrine of evolution founded by Darwin in our time has not only remodelled the science of Biology, but its influence extends through every department of human knowledge. The spirit of Darwinism pervades and animates the whole of modern science. Wherever Nature presents *gradation*, we now suspect *derivation*. Branches and sub-branches of science, which, like Psychology, Anthropology, and Sociology, were formerly ill-defined and vague in scope, under the ruling idea of evolution have now acquired defined forms based on secure foundations. On the burning question of the assumed or actual theological bearing

of the theory of evolution it does not enter into my province to speak this evening. To my mind Darwin has exalted our conception of Nature beyond the theologies. He has taught us that there is no intermediate and direct interference with the course of natural law—he has enforced the lesson that in studying natural science we are concerned only with secondary causes. I cannot do better than conclude in the words of Bacon:—"For certain it is that God worketh nothing in Nature but by second causes; and if they would have it otherwise believed, it is mere imposture, as it were in favour towards God; and nothing else but to offer to the Author of Truth the unclean sacrifice of a lie."[35]

[35] 'Advancement of Learning,' Book I.

V.

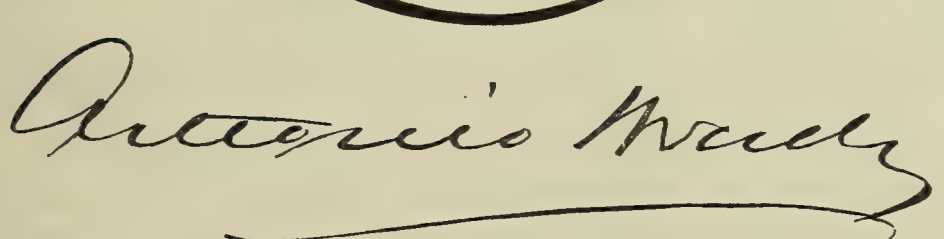
In Memoriam: Sir Antonio Brady, J.P., F.G.S., &c.[1]

On December 12th, 1881, passed away from among us a man whose name will be long identified with the history of practical geological investigation in Essex.

Sir Antonio Brady was the eldest son of the late Anthony Brady, of the Royal William Victualling Yard, Plymouth, by Marianne, daughter of the late Francis Perigal, and was born on the 10th of November, 1811, his age at the time of his death being consequently seventy years. If we may believe the records of the Irish Herald Office, the pedigree of tho Brady family goes back to very early times indeed—to Milesius, of Spain, who was the first conqueror of Ireland! One ancestor was the Most Reverend Hugh Brady, first Protestant Bishop of Meath, consecrated in 1563. Other relatives of Sir Antonio were Dr. Nicholas Brady, compiler, in conjunction with Dr. Tait, of that metrical paraphrase of the Psalms of David which was so long used in our churches, and the Right. Hon. Maziere Brady, who died in 1858, after filling the office of Lord High Chancellor of Ireland on three distinct occasions. His mother's family, the Perigals, came to England at the time of the revocation of the Edict of Nantes in 1685. Antonio Brady was educated at Corf's School, Lewisham, under the Rev. Dr. Waite, Vicar of Greenwich, and Chaplain to the Royal Family. He entered the Civil Service of the Navy as a junior clerk in the Royal Victualling Yard at Deptford, more than fifty years since. In that capacity he served also at Plymouth and Portsmouth, being afterwards promoted, for the marked abilities he displayed, to head-quarters in the Admiralty at Somerset

[1] This short memoir is compiled from information kindly furnished by the Rev. Nicholas Brady, and from Dr. Woodward's obituary notice in 'Nature' for December 22nd, 1881.—Ed.

House. This appointment was gained through the recommendation, it is believed, of Sir James Graham. Here he was so indefatigable in the discharge of his onerous duties that he was made head of the Contract Office, and Registrar of Public Securities in 1854; subsequently he assisted very



materially in reorganising that office, and was appointed the first Superintendent of the new Purchase and Contract Department. He married in 1837 Maria, the daughter of the late George Kilner, of Ipswich, who still survives him.

He had but a small family; one son, the Rev. Nicholas Brady, M.A., now Rector of Wennington, Essex; and two daughters, Fanny Maria, wife of the Venerable William Emery, B.D., Archdeacon and Canon of Ely, and Elizabeth Kilner, unmarried. On his marriage in 1837 Sir Antonio came to reside at Maryland Point, Stratford, where he lived until his death. In 1870 he retired from the Admiralty, and received the honour of Knighthood in recognition of the arduous and unremitting labours he had undertaken in connection with the Civil Service, extending over forty years. His death took place with alarming suddenness while dressing in the morning, the immediate cause being *angina pectoris*, from which he had been suffering for some days. He was buried in the family vault in St. John's Churchyard, Stratford, the funeral being attended by an immense congregation of friends and neighbours.

Sir Antonio Brady took great interest in all the philanthropic and intellectual movements of his time. On his retirement from official life, he devoted himself heartily to aiding by every means within his power the social, educational, and religious advancement of his neighbours; and his name will long be remembered in connection with the Victoria Docks Mission, the Free and Open Church Association, and the various benefit societies in Essex and elsewhere. He took great interest in sanitary reform, and at the time of the cholera epidemic he was most indefatigable in his efforts to relieve the sufferings and distress then rampant. In the cause of technical education he was most zealous, and it was mainly through his instrumentality that the East London Museum at Bethnal Green was inaugurated for the promotion of Technical Art and Science, a work in which he was greatly assisted by Dr. Miller and the Rev. Septimus Hansard.

In the battle for the rescue of Epping Forest from the clutches of the encloser, Sir Antonio was an active and doughty champion. The agitation in favour of right against might, which for thirty or forty years had been intermittently maintained, took a concrete form in 1871, when the Trustees of Lord Cowley enclosed a part of Wanstead Flats. On the

8th of July in that year an immense mass-meeting was held on the Flats, Sir Antonio taking the chair, and as an outcome of that popular protest the "Forest Fund" was established at a meeting held at his own residence on the 14th July, 1871, by a few gentlemen who had for years been earnest in their desire for the preservation of the Forest from the continuous spoliation which was taking place. Sir Antonio Brady was one of the Trustees of the Fund, and for seven years the Society did most useful and honourable work, under the skilful and energetic guidance of the Chairman, Mr. Frederick Young, J.P., and the Honorary Secretary, Mr. W. G. S. Smith. About the same time Sir Antonio was elected by the freeholders one of the Ancient Court of Verderers, an office which was continued to him by the Epping Forest Act, 1878, and which he held until his death, loyally fulfilling its duties and responsibilities. The "Epping Forest Committee" of the Corporation of London, by a resolution passed on January 20th, 1882, placed "on record its appreciation of the services rendered by Sir Antonio Brady to the cause of the preservation of Epping Forest, and of his sincere desire that the toilers of the East end of London especially should not be deprived of so noble a recreation-ground." [2]

In former years Sir Antonio took much interest in the meetings of the Geological, Microscopical, and Meteorological Societies. Up to the time of his death he was a member of the Geological Club, and Trustee of the Meteorological Society. He was an original Life Member of the British Association, where he usually was on the Geological Section, and very generally attended its meetings. He was also a member of the Palæontological, Palæontographical, and Ray

[2] Sir Antonio Brady did not live to see the crowning touch put to the long and arduous work of the rescue of the Forest, by Her Majesty the Queen, on May 6th, 1882, but his active colleagues of the Epping Forest Fund were present; and it was a matter of surprise and comment that, while the mere *ex officio* members of the Corporation received all the rewards and honours, the men who had done battle for the Forest for years, including even Mr. J. T. Bedford, were utterly ignored and neglected!

Societies, the Iron and Steel Institute, the Social Science Congress, the Sanitary Science Congress, Chairman of the Inventors' Institute, and for many years a member of the Society of Arts. Only the day after his death the Brighton Health Congress opened, at which he had intended to be present, having communicated a paper on "Prevention of Smoke in Fire-places" to the Domestic Health Section. He was an original member of the Essex Field Club, and always expressed cordial approval of its work and objects. He attended and took active part in several of our meetings, and in July, 1880, conducted the members to his old hunting-grounds at Ilford, where a most enjoyable afternoon was spent under his friendly and instructive guidance.

Sir Antonio paid much attention to flint implements or "celts," and possessed a very large collection of such objects, many of which he obtained in Denmark, and more than once made journeys to the classic grounds of the river-gravels at Amiens and Abbeville; indeed some of his implements from the latter place formed part of the evidence in the celebrated case of the fossil human jaw found in the old gravel-beds of Moulin-Quignon, which was investigated at Paris by a committee of English and French *savants* in 1863. He was an experienced traveller, having visited most parts of the United Kingdom, the Continent of Europe, especially Russia, and on three occasions he went to America.

It was soon after settling at Stratford that Sir Antonio Brady commenced collecting that rich series of Mammalian remains from the brick-earth at Ilford which has rendered his name a household word among palæontologists. He thus describes the beginnings of the collection in the Preface to the 'Ilford Catalogue':—

"About forty years ago [he was writing in 1874], when the Geology of this neighbourhood was not so well understood, and when even the science itself was in its infancy, the whole scientific, and, I may say, the religious world, was startled by the discovery of the huge bones of some unknown antediluvian animal of gigantic stature, in digging clay for the manufacture of bricks for the Eastern Counties Railway, then in course of construction. By the care of the late Mr.

Gibson, of Stratford, and the kindness of my late friend Mr. Thomas Curtis, the then owner of the field in which they were found, the late Dean Buckland and other distinguished members of the Geological Society were invited down to Ilford to view the bones *in situ*, and much interest was excited by the discovery that they were the remains of a huge Mammoth (*Elephas primigenius*). . . . .

"From that time for about ten or fifteen years—I do not recollect the exact dates—the matter slept, and if any bones were discovered they were in such a soft and friable state that they were not noticed, or at any rate were not preserved.

"About this time it so happened that a son of the late Dr. Buckland, who exhumed and described the bones first found, was dining at my house; and while we were at dinner a note was brought me from my dear friend Mrs. Curtis, the widow of the former owner of the field, to the effect that the workmen in digging for brick-earth had again come upon some more large bones; and, knowing my geological proclivities, placed them at my disposal, and invited me and my friends to look after them. Thus I had the opportunity of disinterring the first bone [the femur of a Mammoth] which formed the nucleus of my now extensive collection."

Encouraged by this "find," Sir Antonio henceforward was unremitting in his labours to secure and hand down to posterity these fragile relics of prehistoric life in Essex, and devoted a large amount of time and money to the work. It may be interesting to quote a few lines from the 'Essex Standard' for March 6th, 1857, giving details of the first discovery of the great tusk of the Mammoth:—

"A few days ago the workmen employed in digging brick-earth at Ilford, belonging to Mr. Curtis, came upon the bones of gigantic animals, some of which proved to be those of a Mammoth; others were parts of a huge *Rhinoceros*, probably *R. leptorhinus;* together with the head of a large *Bos*, and others of minor import, consisting of parts of a horse, and of a species of deer, &c. . . . . The tusk of the Mammoth was the most remarkable bone found on the present occasion, but many curious fossils had previously been discovered in the same field, where many animals seem to have found their last abode. The tusk in question is extremely massive, and has an unusually curved form. It now measures nine feet two inches in length, and four feet eight inches across the bow made by the bend; but the extreme ends are more or

less decayed, and when perfect it was no doubt several inches longer. . . . . Owing to the kindness of Mr. Curtis these interesting fossils were examined *in sitû* by many lovers of science, and on Saturday, February 21st, a party consisting of Sir Charles Lyell, F.R.S., Mr. Waterhouse, Prof. Quekett, Prof. Morris, Dr. Elliot, and Messrs. Brady, Jones, Prescott, Prestwich, and Thompson, with several others, visited the spot and made arrangements for disinterring the fossils. The tusk, we understand, will be deposited in the National Museum by kind permission of Mr. Curtis. The party having spent a most agreeable afternoon at Ilford, dined at Mr. Brady's at Stratford, and finished the evening by examining his cabinet of Natural History, &c."

So rich were these brick-earth fields, that every winter fresh discoveries were made; and when the 'Catalogue'[3] was printed, in 1874, the collection comprised nearly 1000 specimens of Mammalian remains from this one locality! No wonder Ilford became celebrated, and that the Uphall pits were visited and studied by some of the first geologists in England. Very considerable difficulty was experienced in the safe removal and conservation of the bones; having lost, during their long interment, all the natural gelatine, they were so soft and friable that they crushed beneath the touch, and it was not until fresh gelatine had been artificially introduced that the bones could be handled with safety. Sir Antonio always acknowledged his deep obligations to his master in the art of preserving fossil bones, William Davies, F.G.S., of the British Museum,[4] to whose ability and ingenuity

[3] 'Catalogue of the Pleistocene Vertebrata from the neighbourhood of Ilford, Essex, in the Collection of Sir Antonio Brady, by William Davies, of the British Museum, with an introduction by Sir Antonio Brady, and a description of the locality, &c., by Henry Woodward, F.R.S., and William Davies. London (printed for private circulation only), 1874.'

[4] Full details of these processes, so necessary to be understood and practised by future "Elephant hunters," are given in the following papers:—"On the Preservation of Fossil Mammalian Remains found in Tertiary Deposits," by W. Davies. Geol. Mag., vol. ii. (1865), p. 239. "How the skull of the Mammoth was got out of the Brick-earth at Ilford," by Dr. Woodward. Geol. Mag., vol. ii. (1865), p. 92. These papers are quoted in the 'Ilford Catalogue,' and Sir Antonio Brady himself gave a sketch of the *modus operandi* at a meeting of the Essex Field Club on May 29th, 1880 (see 'Proceedings,' vol. i., p. xiv.).

we owe the method by which these ancient relics can be removed from their earthy sepulchres intact.

It is quite unnecessary here to give any minute particulars of the contents of the Brady Collection. In the papers by Mr. Walker and Dr. Woodward, already published in our 'Transactions,' will be found lists and descriptions of all the species obtained at Ilford. Sir Antonio always wished the specimens to go to the East London Museum, in the establishment and success of which he took so much interest; but, as often happens, official red-tapeism prevented this, and the bones of the Ilford Mammoths and their companions may now be studied in the magnificent Palæontological Galleries of the Natural History Museum, South Kensington. Such work as that performed by Sir Antonio Brady is of the greatest value to the progress of Natural Science, and it is there fully illustrated; no more characteristic monument could be desired to perpetuate memories of the energy and foresight of this "genial Elephant-hunter of the Roding Valley"; while his high character as a Christian gentleman, his ready kindness and hospitality, will long endear his name to his friends and neighbours.

(The portrait which accompanies this notice represents Sir Antonio Brady some years before his death. It is drawn by T. Scott from a photograph by Maul & Co., kindly lent for that purpose by Lady Brady, and engraved by Pearson).

VI.

Primæval Man in the Valley of thr Lea.[1]

By Worthington G. Smith, F.L.S., M.A.I., &c.

[Read April 29th, 1882; revised April, 1883.]

Avus Implementorvm omnivm Palaeolithicorvm, qvae svnt a me reperta in Valle Thamesis, apvd Mvsaevm Britannicvm deversatvr.—"CCXLVI. Conyers."

By Primæval Man I mean Man of whom we have the earliest authentic and accepted evidence. I do not refer to the very early inhabitants of Britain commonly known as the Silurian or Neolithic tribes, or to the Kelts, but to that great cohort of men who once lived near ancient river-sides, and there left their chipped unpolished weapons and tools of flint, chert, felstone, quartz, quartzite, porphyry, and various other stones. No doubt, as I think, these river-side men were preceded for vast periods of time—though possibly not where England now is—by other men or men-like animals, and these, our (at present unknown) remote precursors, might perhaps more properly be termed primæval men. The evidence, however, of the existence of such early tribes (even if any evidence has at present been discovered) is, to me, of a slight and uncertain nature. I prefer therefore to consider that little or nothing is known of primæval man prior to the deposition of the beds of gravel, sand, and loam generally found as terraces bordering our present rivers or their affluents. These gravelly, implementiferous positions are chiefly confined to the rivers of North-Western Europe, although stone weapons of apparently vast antiquity have now been found in drift beds generally bordering the rivers of all four quarters of the globe.

[1] [We are greatly indebted to Mr. Worthington G. Smith for the numerous woodcuts illustrating this paper, drawn and engraved by himself. Since the reading of the essay it has been carefully revised and brought up to date by the author.—Ed.]

The precursors of the river-side men have, as far as we know, left no implements of stone for recognition; it is probable that the very earliest men used naturally-broken splinters and flakes of stone as tools and weapons. At last the time arrived when some individual discovered that by striking a hard, tough stone—like a quartzite pebble—on to a hard and brittle one like a block of flint, that sharp knife-like splinters, slices, or flakes would fly off from the flint, and these splinters were the first artificially-made implements used by the earliest men. The discovery of the art of splintering or flaking was quite possibly unpremeditated, and arose from seeing a block of flint accidentally shattered.

The ancient river-side men, to whom I refer as primæval men, are everywhere known as Palæolithic men, because they were the men who fabricated the most ancient stone implements yet accepted as undoubted human work. The rough unpolished stone implements of the Palæolithic men are distinguished in various ways from the tools made by the Neolithic men of later times. The former and more ancient tools are commonly found embedded in undisturbed gravel, sand, or loam, in company with fossil bones belonging to animals many of which are now extinct. These implements are never polished, and they are often abraded or water-worn, owing to their being transported and washed about by the ancient stream on whose banks they were made. Neolithic implements, or implements belonging to a very much more recent period, are generally found on or but little beneath the surface; they are frequently partly or wholly polished, and the bones found with them are neither in a fossil nor semi-fossil condition.

It is to the works of the Palæolithic men—and chiefly those men who formerly lived in the Lea Valley—that I now propose to direct attention. These old river-side men lived on the ancient stony banks of the Lea; they picked up the flints that were at their feet, and from these stones fabricated their weapons and tools. Successive floods of river-water, often slight, repeatedly covered up these flint tools with sand, loam, or gravel; and now, when excavations are made in the

old river-terraces, the weapons and other instruments of stone are disinterred with the excavated material. These implements of flint are veritable "sermons in stones"; they picture facts to us that it is impossible to question, and they give us outlines, sometimes very plain and sometimes very dim, of the men who made and used them.

After these preliminary remarks, I will proceed to say where the Palæolithic tools are to be found in the Lea Valley. I will then describe the tools themselves, their positions in the gravels, and some of the objects commonly found in association with them; and lastly, I will glance at the probable or possible cultural *status* of the men who made the instruments.

The localities for Palæolithic implements in the Lea Valley are very numerous. If we restrict ourselves to the district running north of the present point of confluence of the Lea with the Thames to Cheshunt, we find on the west bank of the Lea a vast deposit of river-gravel about fifteen miles long. Now towards the top of the whole of this long bank of gravel there was in remote times a large cohort of Palæolithic men; for on every part of this terrace (in the higher positions) from the Thames to beyond Cheshunt the tools and flakes of the ancient river-side men abound. There is far less gravel on the Essex side of the Lea, but wherever the higher gravel is there also are the buried tools of primæval man and the fossil bones of the animals that lived at the same time with him.

Before I proceed to distinctly point out the exact spots where Palæolithic implements are invariably found, it may perhaps be well to indicate the positions where they are *not* to be found, for if search is not made in the right variety of gravel, or in the right places belonging to that gravel, one may look for years and never light on a flake. In the first place, then, it is almost useless to examine the gravels on the hill-tops, or such gravels as are found at Buckhurst Hill, for these are generally glacial in age and supposed to be unproductive of implements. Personally, I may say that I consider the subject of the unproductiveness of glacial gravels, as regards implements, to be a question that requires further

examination. The pebble-gravels also, such as one sees in the large pit in Silver Street, Edmonton, and on the higher positions to the west of Enfield, are unproductive; these gravels are extremely ancient, and probably of marine origin. Lastly, the lower gravels in the immediate neighbourhood of and under the present streams are generally unproductive of implements; they, however, now and then contain a stray example or two, undoubtedly washed down from a higher level.

The *productive gravels* in the Lea Valley are almost invariably those found between the 50 feet and the 100 feet contour-lines as marked on the Ordnance Maps. In other words, where the surface of the ground is between 50 and 100 feet above the Ordnance datum, there the implements will certainly be found. If one goes above the 100 feet line the implements become rare, although not absent; for in one instance I found an implement near Ealing Dean in gravel 164 feet above the Ordnance datum. Mr. Evans records the finding of an implement 300 feet above the Valley of the Darent, in Kent, and 500 feet above the level of the sea; Mr. Benjamin Harrison, of Ightham, in Kent, has found implements in the valley of a tributary of the Medway, a southern affluent of the Thames, at 400 feet above the Ordnance datum and 150 feet above the nearest stream; and Mr. F. C. J. Spurrell has found an implement near Erith, at a height of 175 feet. As a rule, though not without exception, it may be considered that the higher the implements are found above the Thames-level the more ancient they are. In positions removed from a great river the height of the nearest stream must always be considered. There is no tributary of the Thames near the 164 feet position mentioned by me north of Ealing; and it seems impossible to avoid the conclusion that the Thames or some other river once flowed at that level, and that primæval man made his implements on the elevated terrace. Near where I live at Highbury, there is gravel close to "Christ Church" at 140 feet above the Thames, and there I recently saw an implement disinterred. This high position, clearly, was once

part of the margin of the ancient Thames. If we imagine water to be continuous over where London now is, at the 164 feet position near Ealing a space of four miles is required across the Thames to find the corresponding southern bank at Richmond. This height would exactly reach the top of the nave-roof of St. Paul's Cathedral, and nearly every house in London would be under water. The 400 feet position would only just leave the cross and ball of the Cathedral out of the water. St. Paul's is 365 feet high, and it stands about 65 feet above the Ordnance datum. It follows therefore, from these figures, that since primæval man lived on the banks of the old, wide, shallow Thames, the river has excavated its valley to a depth corresponding with the height of the cathedral for many miles east and west of London. The time required to excavate such a valley must be enormous—at those remote times Hampstead and Highgate (supposing for convenience that these places have not since been lowered by denudation) could not have stood higher above the shallow Thames than now do Homerton, Clapton, and Leyton above the Lea. There are distinct traces all round London of primæval man's presence whilst the Thames was excavating the valley from 164 feet down to 50 feet above its present level.

When the 50 feet level is left, and a descent is made into the valley of the river, the implementiferous deposits speedily vanish; and this fact seems to indicate that, when these lower gravels were deposited, Palæolithic men were not present. A magnificent view of one of the best of the Palæolithic terraces of the Lea may be seen from the neighbourhood of Leyton Railway Station, or Temple Mills, near Stratford. On looking westwards across the Lea, towards North London, Hackney and Homerton can be seen on the left, and Stamford Hill nearly two miles to the right. Homerton Church is 54 feet and Stamford Hill 107 feet above the Ordnance datum. This is the best terrace in the Lea Valley; the whole two miles from Victoria Park to Stamford Hill is one mass of implementiferous Lea-gravel and sand, averaging 12 or 13 (but sometimes 20, or even 30) feet in thickness, and resting

on the London-clay. The primæval Palæolithic men lived in large numbers on this great bank, and when they looked eastwards towards Stratford they did not glance over a grassy flat as we do now, but over a shallow and possibly wide river with a surface 40 or 50 feet higher than at present. On the opposite, or Essex side, owing to the rains of many centuries, the banks or terraces are not so well defined as on the Middlesex side, but still the positions are really there; the gravel, the implements, the fossil bones, and the shells of fresh-water molluscs are precisely the same on one side of the river as the other. If a journey is made by railway from Hackney Downs Station to Cheshunt, the old Palæolithic banks can be seen in several places, in some instances as much as four miles apart from east to west across the Lea. In many places the old banks are obliterated; this obliteration has been probably caused by the rainfall of many thousands of years, the rains gradually washing away the softer materials of the banks, and leaving the harder and more enduring positions intact.[2]

It is almost unnecessary to mention the fact, pointed out in so many geological books, that in the remote Palæolithic times now under consideration England was probably part of the Continent of Europe; that the Lea was a wide but shallow river, sometimes more like a torrent than a quiet stream, and constantly changing its bed. The Lea, then as now, was an affluent of the Thames, the latter at that time being a large and rapidly-flowing tributary of the Rhine which last emptied itself into the North Sea. The sea of course did not flow between Hampshire and the Isle of Wight, and what is now known as Britain then extended much further southwards, where the English Channel now is, westwards towards

[2] When Prof. Hughes read his paper on the "Antiquity of Man" before the Victoria Institute, one speaker, a Fellow of the Geological Society, said the embankments or terraces of the Somme were not continuous, and so could not have kept the river in. Prof. Hughes forgot to reply to this objection, but the explanation is of course perfectly easy when subsequent denudation is admitted. This alteration of the surface is proved by the present condition of various works of known age—for instance, the Roman roads in Cambridgeshire are distinct when they cross the hard chalky soil, but are quite obliterated in clayey positions.

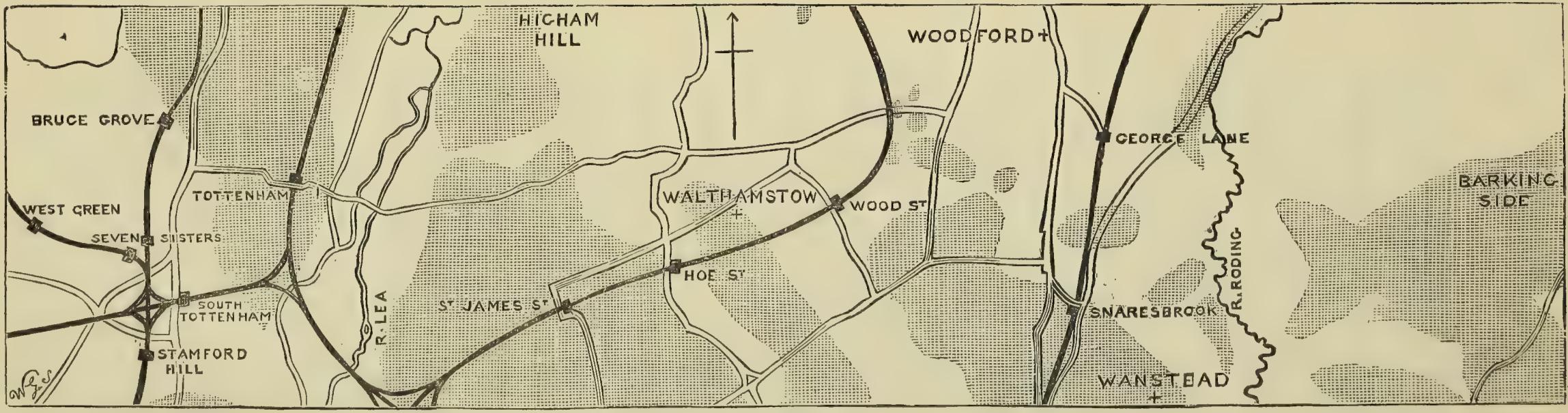


FIG. 1.

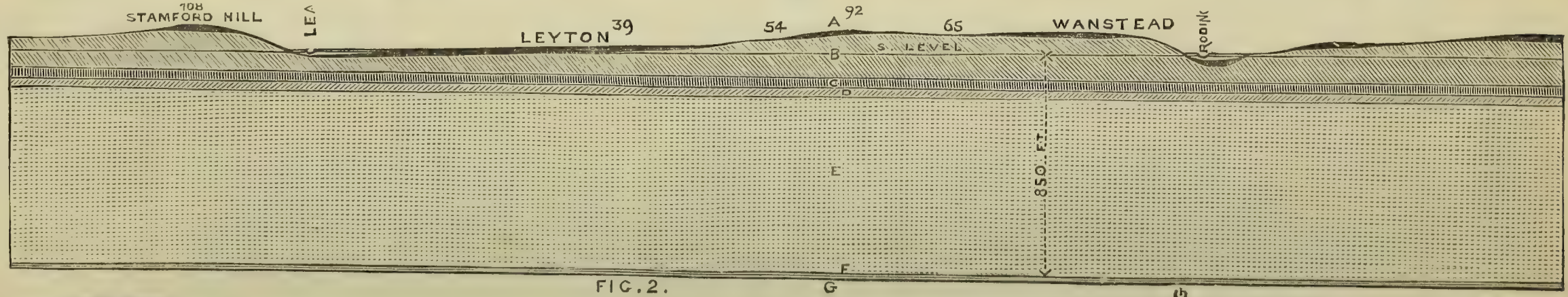


FIG. 2.

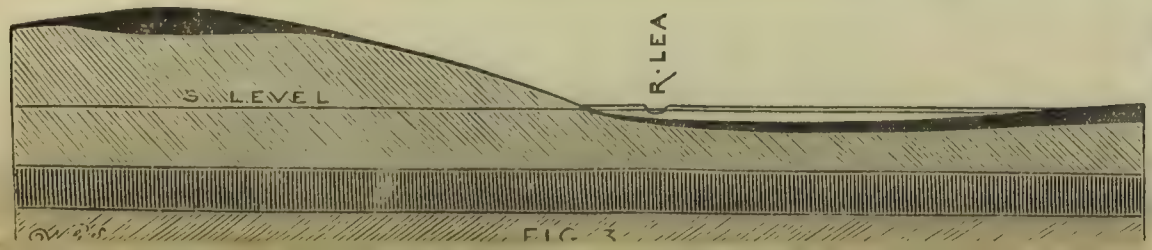
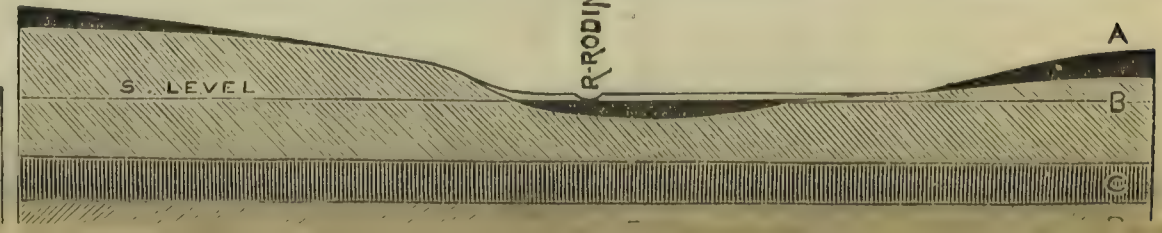


FIG. 3.



America, and northwards towards Iceland. At this period of time Clapton and Homerton on one side and Leyton and Stratford on the other were the points where the Lea poured itself into the Thames. The great width of the stream in Palæolithic times is proved by the presence of the gravel-terraces; that these terraces were really the old river-margins (now sometimes a mile or even four miles from the stream) is proved by the abundance of fossil shells of land and fresh-water molluscs contained in them.

In fig. 1 I have engraved a small portion of North-east London, including Tottenham, Stamford Hill, Walthamstow, Woodford, Snaresbrook, and Barking Side. The dotted portion shows the disposition of the gravels, and their positions in regard to the Lea and Roding. No doubt the gravel banks were at one time continuous, and so prevented the river from overflowing the country, but centuries of denudation have now removed part of the gravel. The Plan is engraved to a scale of one inch to a mile, and at fig. 2 is a section of the ground to the same scale; the vertical scale being 800 feet to one inch. The solid black portions on the tops of the elevations show the implement-bearing gravels, and the black below the sea-level line is the gravel beneath the Lea and Roding. The figures indicate the heights above the Ordnance datum or mean sea-level. B represents the London-clay on which the gravels rest; C, the Woolwich and Reading beds; D, Thanet sand; E, Chalk; F, Upper Green sand; G, Gault. Beneath the general section are two other sections,—figs. 3 and 4, through the rivers Lea and Roding, —showing the gravels contiguous to and under the streams. These are drawn to a horizontal scale of three inches to the mile, and a vertical scale of 320 feet to an inch, to more clearly show the gravels as they rest on the London-clay. The plan and sections are founded, by permission of Mr. William Whitaker, on the admirable geological Model of London in the Museum of Practical Geology in Jermyn Street.

The enormous power of the ancient Lea and Thames during flood-times is proved by the huge masses of sandstone frequently met with in the gravel. I measured a block last

month (March, 1882) dug out, with implements, at Stamford Hill; it measured 1 ft. 5 in. by 1 ft. 4 in. by 9 in.; another from Stoke Newington measured 1 ft. 6 in. by 1 ft. by 1 ft.; I also have a record of a block of quartz at Shacklewell 1 ft. 2 in. in diameter. At Hackney I have seen sandstone blocks weighing 2, 3, 4, and even 5 cwt. each excavated from the gravel; these were probably carried down the old stream on blocks of ice; some exhibit glacial striæ. The flints now found in the gravels at one time belonged to the chalk; they were probably set free soon after the chalk emerged from the sea by water dissolving away the chalky matrix. Glaciers and blocks of ice then moved the stones southwards. The land at that time was many feet higher than now, and consequently the cold on the high lands was intense. When in warm weather the ice and snow melted, the stones were brought down to lower positions, and it was on these lower positions that the primæval men chiefly found the flints and manufactured them into tools. The chalk whence the flints were derived was no doubt that which crops up in the chalk hills of Hertfordshire, for the Lea rises near Dunstable, in South Bedfordshire, in a position surrounded by chalk-hills, some capped with glacial gravels.

The Lea receives the waters of the Stort from the east, near Hoddesdon; the Stort itself rises six miles direct southwest from Royston. Mr. John Evans records the finding of two Palæolithic implements in the Valley of the Stort, one from Bishop's Stortford, and the other two miles further to the north, from Pesterford Bridge.

That the land was continuous in Palæolithic times over the Straits of Dover and the Solent Sea seems proved by the stratification of the rocks, which agrees on both sides. The implement-bearing gravels are also in some places continuous, and as a consequence the gravelly beaches of our Kentish and Hampshire coasts are all implementiferous. Every geologist is acquainted with the beautiful Palæolithic instruments found on the beach near Reculver and Herne Bay, some of which are exhibited in the Geological Museum in Jermyn Street. I have a considerable number in my own

collection; and from the stony beach of Hampshire, opposite the Isle of Wight, I have more than one hundred examples; some of these, until recently found by me, had been tossed about so long in the sea that they were, when found, almost as smooth as the ordinary large oval pebbles of the beach; others of the beach implements have marine growths upon them, both animal and vegetable.

In a paper read by me before the Anthropological Institute on June 25th, 1878 (and published February, 1879), I mentioned for the first time various localities for Palæolithic implements at Lower Clapton, Shacklewell, Stoke Newington, Edmonton, Tottenham, Waltham, and Cheshunt; these localities I identified at that time with the Valley of the Lea. Since then the implements, fossil bones, and shells have several times been exhibited by me before the Anthropological Institute, the British Archæological Association, and once before the Archæological Institute. The vegetable remains have been shown by me before the Scientific Committee of the Royal Horticultural Society. I have also several times communicated the localities for implements to 'Nature.' The positions on the Lea Valley of my discovery are chiefly on the west bank; starting from the south, the first place is London Fields, near Kingsland; then Homerton, Hackney, Lower Clapton, Mildmay Park, South Hornsey, Abney Park Cemetery, Stoke Newington, Shacklewell, Stamford Hill, Tottenham, Edmonton, Enfield, Forty Hill, Waltham, and Cheshunt. On the east bank, Plaistow, Stratford, Leyton, Wanstead, Walthamstow, Leytonstone, Higham Hill, West Ham, Forest Gate, and Upton. Leaving the Lea Valley for the Roding, I may add Barking, East Ham, and Ilford; and further east still, Grays Thurrock, Tilbury, Mucking, Orsett, and Southend. All these localities were first lighted on by myself, for no implements had been traced with any certainty to the Lea till I found the stone tools *in sitû*. One implement had been previously found by Mr. John Evans at Highbury, in the Valley of the Thames; another in a road at Clapton by Mr. Gaviller; a third also in a road by Mr. Anscombe. These three examples no doubt raised strong presumptions of their local origin.

From the enumeration of the localities in the Lea Valley, and from the large number of implements there found, it may be judged how rich the London district is in the relics of primæval man. But if the localities are many on the east side of London they might easily be quadrupled on the west side, where I have found similar relics. It will be seen that when, years ago, our English geologists were rushing from London by rail to visit the French drift "quarries," as they were termed, they were actually passing English positions equally rich with the French.

Mr. John Evans was the first to suggest that the slopes of the Hackney Brook were implementiferous, and, acting on this hint, I have examined the whole of Lea Valley from north to south. Of my discoveries in this Valley I esteem most highly that of the "Palæolithic Floor" or working place at Stoke Newington, for here we have three deposits of gravel and sand superimposed, each deposit clearly marking a distinct era in the great and prolonged Palæolithic age.

Having enumerated the localities, I will now proceed to the material in which the implements are found, and indicate what may be learned from the gravel and sand when seen in section.

The best sections and those most familiar to me are immediately north and north-east of Stoke Newington Common, a position from 80 to 90 feet above the Ordnance datum. In the accompanying illustration (fig. 5) the upper figure shows a section 300 feet in length through the gardens between Alkham and Kyverdale Roads. From 4 ft. to 4 ft. 6 in. beneath the surface at this place, indicated by A A A in the upper figure, there is a thin 5 or 6 in. stratum of subangular flints covered by sandy loam and humus. The 6 in. stratum of subangular flints contains many Palæolithic weapons and tools, and innumerable artificially made flakes; this stratum I have termed the "Palæolithic Floor," because it is a true "floor" or working place where the more recent Palæolithic men lived and made their instruments of stone. Upon this floor, weapons, tools, flakes, hammer-stones, anvils, and bones are to be found in the very positions where they were

left by primæval man in Palæolithic times. At 8 feet below the "floor," and about 12 feet from the surface of the ground, is a bed of gravel and sand 8 ft. in thickness, containing implements of older date; this bed is shown at the base of both the upper and lower sections in fig. 5.

To more clearly show the nature of the "floor," the 60 feet of the upper figure (where marked) is engraved below to a larger scale; B is the 12 ft. gravel containing rolled fossil bones and abraded Palæolithic implements; C is fine buff-coloured sand, often full of fossil shells of land and fresh-water molluscs; D D D is the "floor," with its numerous

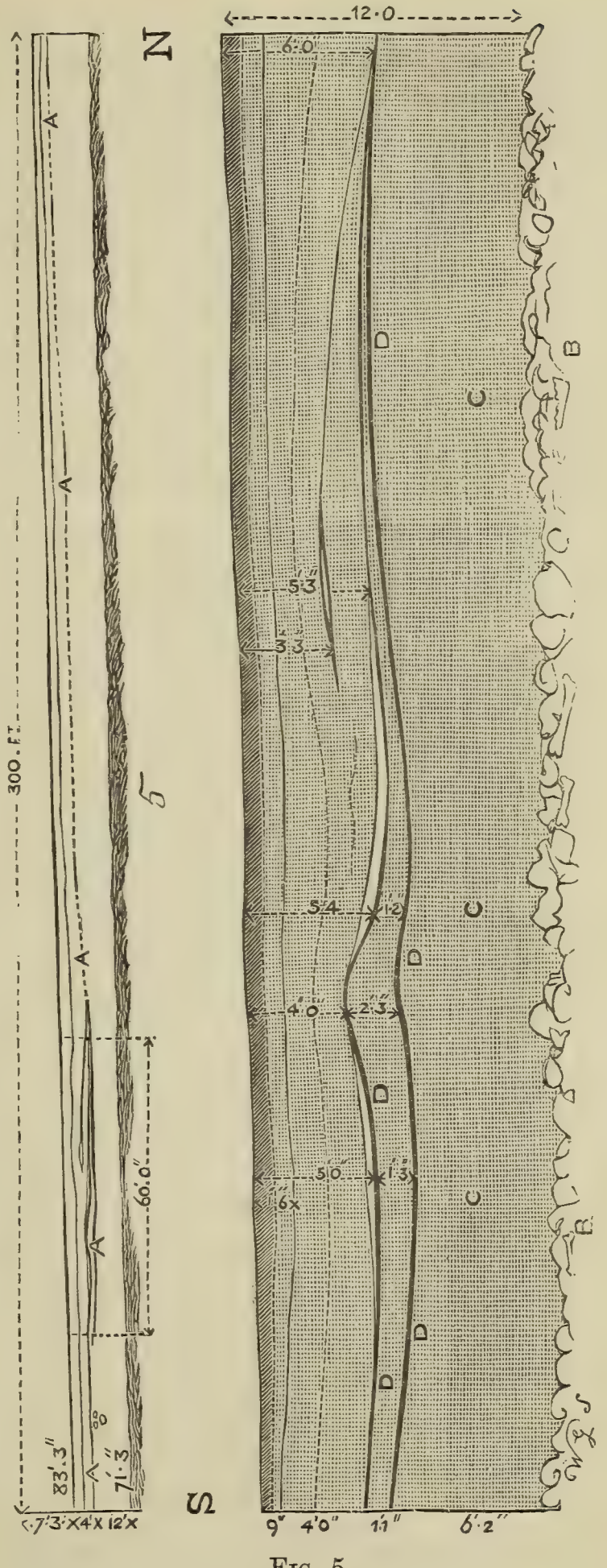


Fig. 5.

unabraded tools and flakes; in the part illustrated the "floor" is in duplicate. After the men had made their tools on the "floor" where the lower D's occur, a slight flood of water covered up the tools with a thin coating of sand; the men then walked over the newly-deposited material, and made other tools on the new "floor." The two white streaks on the top of the upper "floor" are London-clay mixed with sand. Sometimes the tools and flakes are to be seen in this clay, but of course they were washed into it in Palæolithic times by floods. Above the "floor" is sandy loam and loamy sand; the uppermost part, and sometimes the whole of the material above the "floor," is not water-laid; in other words, it is one form of "trail" and "warp"; above this "trail," and where the darker tint is engraved, is humus, with Neolithic celts and flakes.

When the material above the "floor" is carefully removed, as I have so had it removed for me several times, the surface of the old working-place is exposed. The stones are chiefly subangular broken flints, under the average size, the crust sometimes ochreous, at other times grey, quartzite pebbles, pieces of sandstone, a few pieces of quartz, cretaceous fossils, and numerous small grey flint pebbles, with traces of chalk. Intermixed with these stones are large numbers of keen lustrous flakes and many implements, all sharp, and as a rule (not without exceptions) small in size and well made, some so exquisitely made as to rival the best Neolithic work. With these tools, fossil bones, mostly broken, belonging to the Mammoth, Horse, Bison, and Reindeer, occur with broken tusks, teeth, and antlers of the same and other animals; human bones and teeth I have never been able to light on. The reasons why human bones are not found amongst the fossils are many, and they have been pointed out by every writer who has treated of the subject of the antiquity of man. Human bones are very liable to decay; few bones so small as human bones are ever found. Primæval men may have buried their dead, but if the bodies were left unburied, hyænas and other animals would eat every scrap. Still the human pelvis bones are large, and heavy enough for preservation;

and no doubt the time will some day arrive when human bones will be found, and we shall be able to build up human skeletons of Palæolithic age. It frequently happens that the remains of small bones are found, but in so decayed and friable a state that it is impossible to identify or preserve them, or even remove them from the wet sand. When human bodies are once buried in a stony place where water is able to filter through, as in the Lea-gravels, such bodies probably soon utterly perish. As an illustration of a fact of this class I may say that about four years ago I had an opportunity of opening several cairns on the mountain-tops of Central Wales. After the nodular covering-stones forming the cairns were removed, the Kist Vaens or rude stone coffins were exposed. On removing the heavy slabs of stone from these coffins, a bed of fine clay was exposed at the bottom, on which the dead bodies had been laid in a contracted position, *i. e.*, with the knees drawn up to the chin, and the body laid in the grave sideways. The bed of clay was perfectly clean and pure in colour, but there was no trace whatever of the body in any of the cairns—every vestige had disappeared. These Kists may be two thousand years old—a very small item in the probable age of the river-terraces of the Lea.

No animal can live long unless water is accessible; therefore in Palæolithic times, as now, the men found it convenient to live near the water; the Mammoth, the Reindeer, the Rhinoceros, the Bison, the Lion, the Horse, and other animals also frequented the river-margins for drink. It was on the river-margins that the men chiefly hunted these beasts with their weapons of stone, the bones and tusks of the animals being left where we now find them, amongst the constituent stones of the gravel. I have many times seen such tender things as leaves, small pieces of wood and small crushed branches, generally, especially is this the case with the leaves, very friable. Molluscan remains in immediate contact with the "floor" sometimes occur, and I have seen them both below and above it, and in contact with the bones and implements. Three or four feet below the "floor," shells are sometimes very common. Both under and above

the "floor" are occasional seams and blocks of London-clay, brought from a short distance to the north-west, where the clay comes to the surface. As a rule there are no very large blocks of flint or other large stones on the "floor." The non-waterlaid covering mass often disturbs the "floor," ploughs it up, and pushes underneath it. The twisting, contortion, and undulation of the material above the "floor" seem to prove that it was laid down by moving ice from the north. This ice-deposited "trail" and "warp" is full of small whitish pebbles, fixed in the tenacious material at various angles. Abraded and whitened implements are also met with in the "trail," examples no doubt caught up from

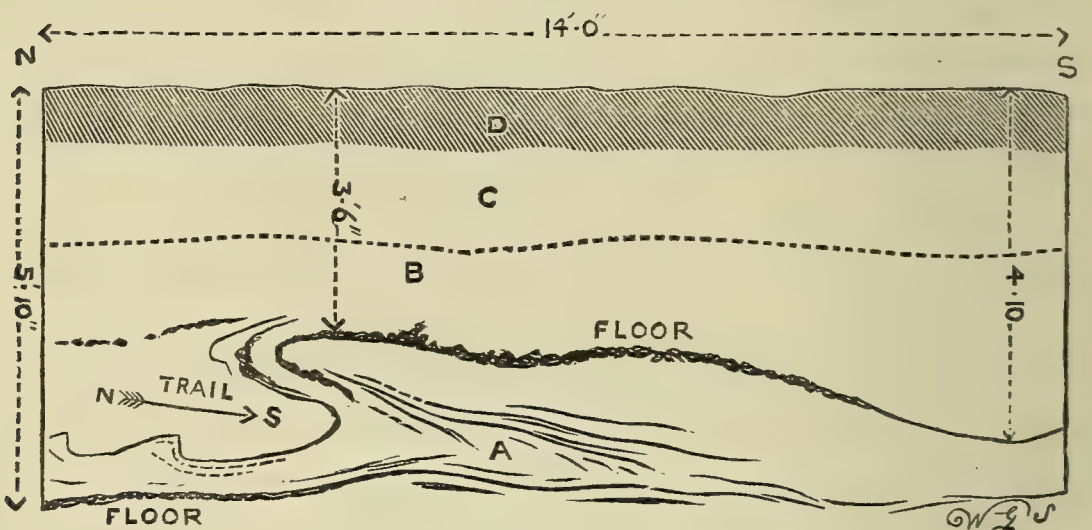


Fig. 6.

old exposed surfaces by the ice-sheet, and brought from a distance to their present position. No Palæolithic implements occur above the "trail"; the "trail" seals up all the relics of the Palæolithic age, and, as far as the evidence of north-east London goes, Palæolithic man had quite retired before the "trail" and "warp" were deposited. When implements are found on the surface, the ground may have been denuded, and the implements exposed.

Fig. 6 is a measured section through the "floor" facing west, on the other side of the section, illustrated in fig. 5; the "floor" is seen at from 3 ft. 6 in. to 4 ft. 10 in. beneath the surface; muddy trail, with sand and a few stones, is present at B and C; D is humus. In the direction of the arrow, from north to south, the "trail" is seen pushing

under and upheaving the "floor" with its implements; the Hackney Brook is towards the south, and a flooded brook to the south would hardly upheave the "floor" from the north; A is a mass of London-clay and sand brought from a distance and pushed under the "floor" by the advancing "trail" from the north. Where the "floor" has been crumpled and disturbed the implements show a very small amount of abrasion; when the "floor" is covered by the stratified sand or mud of the river, the tools are all as sharp as on the day they were made.

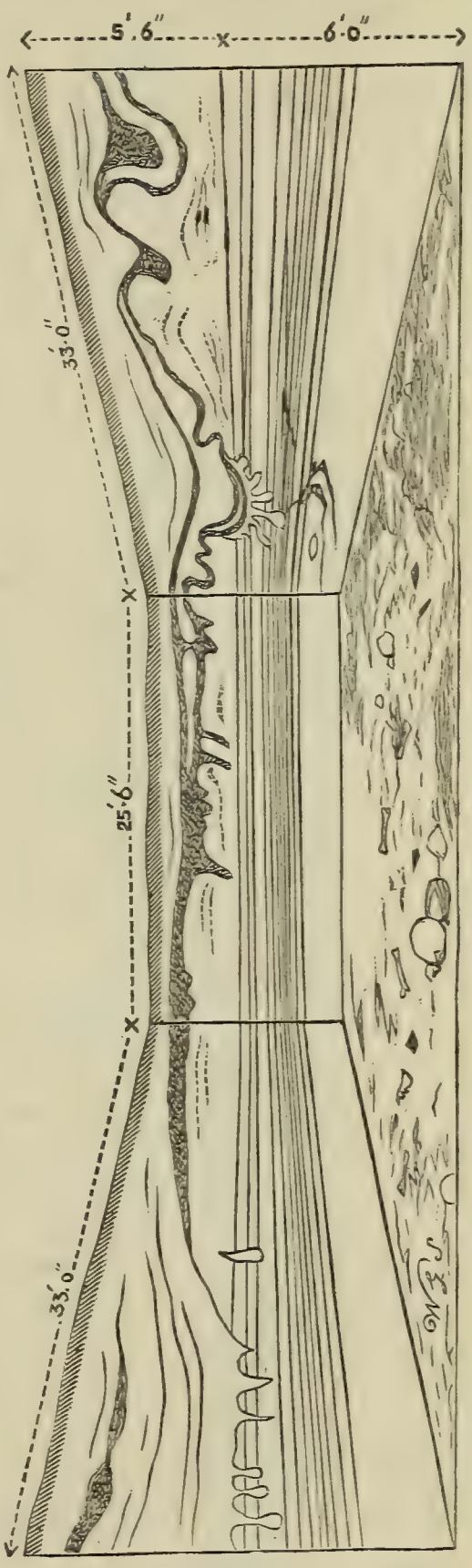


Fig. 7.

It fortunately happens that very near the sections here illustrated, *viz.*, at 270 yards west by north from Clapton Railway Station, and just south of Caroline Street (marked on Stanford's map), one or two other cuttings have quite recently been made; these show admirable sections of characteristic "trail." At fig. 7 a section facing south is engraved to scale; and at fig. 8 the end of the section is further enlarged to show the "trail" and "warp" above, and the stratification below. The section is 11 ft. 6 in. deep, and just reaches the top of the stratum of gravel which contains implements intermediate in age between those of

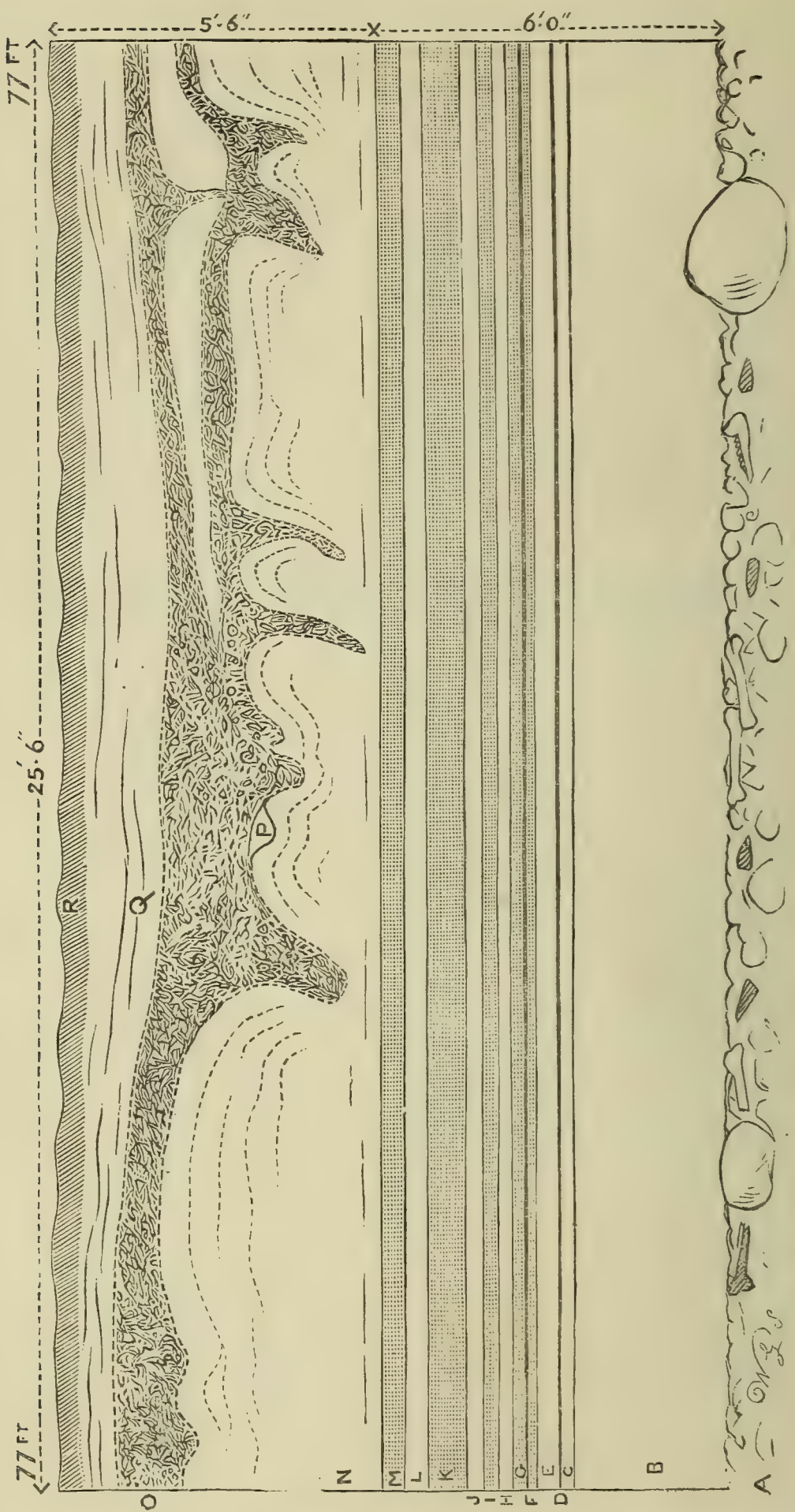


FIG. 8.

the "floor" above and those found from 20 to 30 ft. beneath the surface. The "Palæolithic Floor" on fig. 8, if present, would be just above the horizontal bands of stratification, but the "trail" at this spot has swept it away; it, however, occurs in a perfect state a few yards off. Beginning at the top, the reference-letter, R, is humus; Q, mud belonging to the "trail"; P, a pocket of London-clay; O, "trail"; N, Palæolithic sand and loam crumpled and disturbed by the "trail"; M, dark sand and clays; L, light sand and clay; K, dark sand and clay; J, yellow sand; I, red sand; H, light sand and clay; G, dark sand and clay; F, red sand; E, yellow sand; D, red sand; C, sand, almost white; B, buff sand, sometimes full of the fossil shells of land and fresh-water molluscs. These sands represent the sandy margin of the old Thames, now four miles distant from this spot. Some of the shells found in it by me have been kindly named by Dr. J. Gwyn Jeffreys; the series is probably very imperfect, as the time I have for geological matters is extremely limited; but no doubt the list is typical, as I have many times met with the species hereafter mentioned; other species may be more rare or local:—

1. *Corbicula fluminalis*, Müll.—Extremely common.
2. *Hydrobia marginata*, Mich.—Not uncommon.
3. *Sphærium corneum*, Linn.
4. *Pisidium fontinale*, Drap.; var. *henslowana*, Jen.
5. *P. amnicum*, Müll.
6. *Unio tumidus*, Phil.
7. *Bythinia tentaculata*, Linn.—Extremely common, with abundant free opercula.
8. *Valvata piscinalis*, Müll.; var. *subcylindrica*.
9. *Planorbis albus*, Müll.
10. *P. complanatus*, Linn.
11. *Limnæa auricularia*, Linn.
12. *L. truncatula*, Müll.
13. *L. peregra*, Müll.
14. *Ancylus fluviatilis*, Müll.
15. *Helix concinna*, Jeffr.
16. *H. nemoralis*, Linn.

Dr. Jeffreys was good enough to add the following note:—"The occurrence of *Pisidium fontinale*, var. *henslowana*, as well as the *tout ensemble* of all these fossil shells, induces me

to believe that they had been thrown up by floods on the banks of a large river such as the Thames." A mile to the west, at Highbury, other molluscan genera are represented. A list of the Highbury shells is given by Mr. John Evans—'Stone Implements,' p. 524. Drift wood, twigs, and even carbonized leaves are commonly found with the shells; this drift wood must not be confounded with the silicified wood which also occurs. Both the drift wood and the leaves are beautiful objects under the microscope, the cellular structure being perfectly preserved.

I now come to the bed of gravel indicated at B (fig. 5), and A (fig. 8). It is found at an average depth of 12 ft., and descends to 20 or 30 ft. from the surface; this drift contains, chiefly in its upper parts, lustrous subabraded Palæolithic implements of medium age. All these tools have been more or less moved and relaid by the agency of water; none are quite unabraded; bones, teeth, and tusks of the Mammoth also occur, with other mammalian remains, drift wood, &c. This deposit has been described by Prof. Prestwich in the 'Quarterly Journal of the Geological Society,' 1855, vol. xi., p. 107, where he also gives a list of Shacklewell fresh-water shells. The material is remarkable for containing immense blocks of sandstone, probably never moved by water alone; that these stones fell from blocks of drifting ice seems extremely probable. They must have been brought from the north long prior to the deposition of the "trail," and probably long after the time when other immense blocks found at 20 and 30 ft. at the bottom of the gravel were deposited. The stones forming the Lea-gravel are principally derived from the glacial beds at the North of Middlesex and South Hertfordshire, which in their turn chiefly originated in the breaking up of the chalk; the flints are generally subangular smoothened blocks; quartz and quartzite blocks and pebbles are frequent, hornblendic granite less so; silicified wood often occurs with numerous fossils from the chalk. Generally in the deepest pits the third and oldest class of implements is found; the examples are rudely made, mostly massive, and deeply ochreous in colour.

It commonly happens that the higher the gravels above the present rivers the older they are, but here we have an instance where the newer gravels and more recent implements are from 8 to 26 ft. higher than the old.

Having noticed the material in which the stone implements of the Lea are found, I will now describe the tools themselves. I need not discuss the question as to whether they are of human origin or not; I agree with Prof. Hughes, of Cambridge, who said before the Victoria Institute that he would not waste time to discuss the point. To me they are as certainly of human origin as is the Parthenon at Athens or the cartoons of Raphael. The implements owe their formation to thinking heads, to true eyes, and to uncommonly skilful fingers. Flint implements from the drift have sometimes been described as rude, naturally-broken blocks of stone; but the fact really is, many of the weapons and tools are so beautifully and finely made that it is only safe to move them from place to place with the most careful packing, to protect them from injury. Many of the oval, ovate, and tongue-shaped forms are almost mathematically true in outline.

After a somewhat long and very painstaking experience of the flint implements of the Lea Valley, I can, as I think, distinctly refer them to three different ages, all three far distant from each other. As the implements are thrown out of the pits with the ballast, we sometimes find the massive club-shaped implements, rudely made, with heavy butts, greatly abraded, and deeply ochreous. They are rare in the Lea Valley, and I am inclined to consider these as the most ancient implements yet known. They have not acquired their ochreous colour in the Lea-gravel, and they are far more water-worn than the typical Lea implements; they form the first and oldest class, and I consider them as "derived" (as geologists say), and not innate with the gravel in which they are now found. They differ in the same way from the "Palæolithic Floor" implements as do fossil shells from the chalk, as compared with the more recent Molluscan remains of Palæolithic gravels. Implements of

three distinct ages are not confined to the valley of the Lea or the Thames, as they are met with at Canterbury, Bedford, Southampton, and elsewhere.

In looking for the oldest human work it would be unreasonable to expect symmetrical implements. The very earliest weapons and tools used by our most remote precursors must have been natural or accidentally broken stones—naturally pointed stones, and stones with a naturally suitable cutting or chopping edge; the first attempts at implement-making must have been at the time when the primæval savages "quartered" a stone by smashing it, and then selected pointed and knife-like pieces of this stone for tools.

None of the following rules are without exceptions, for amongst the implements, which are usually very large, a very small specimen may now and then occur; and amongst those which are usually very small there may be at times a large example. The lustre and deep ochreous tints may at times vary a little. Notwithstanding exceptions, when all the characters are taken together, the distinctness of the three classes will hold good.

The oldest known tools, then, are found at the base of the 20 and 30 ft. excavations; they can, according to my estimate, be recognised by the following characters:—they are generally lingulate, or club-shaped, with a heavy butt, often rudely ovate, never sharply acuminate, generally large and very rude, frequently with a thick, ochreous crust, and always greatly abraded, as if they had been tossed about for ages in the sea. Some of these implements are so much abraded that they have lost almost every trace of flaking. These old implements acquired their ochreous crust before they were buried in the gravel, as they occur amongst sub-angular lustrous flints, and, though of flint, they also occur in chert gravel, where only the implements and a few stray stones exhibit the ochreous crust. I have seen no trimmed flakes or scraping tools belonging to this older age. At Canterbury they occur in thin seams of distinct ochreous material, where all the contained flints have an ochreous surface. All these older tools were made at a long distance

from where they are now found. An implement of this class is illustrated, one half actual size, at fig. 9 (No. 172 in my collection), and was found by me at Wanstead.

A very important point has now to be especially noticed: when these ochreous instruments were originally tossed about and buried in the gravel, some of them became chipped, and even broken. Now the chipped and broken surfaces of these older implements are never ochreous, but invariably of the natural colour of the flint, and *lustrous*. This lustre has been acquired since the gravels were laid down, and it exactly agrees with the lustre of the sub-abraded lustrous implements of medium age found from 8 to 10 feet above the ochreous ones. It follows, therefore, that the lustrous implements, although enormously old, can only be as old as the time when the ochreous ones were bruised and broken in the gravels where they are now found.

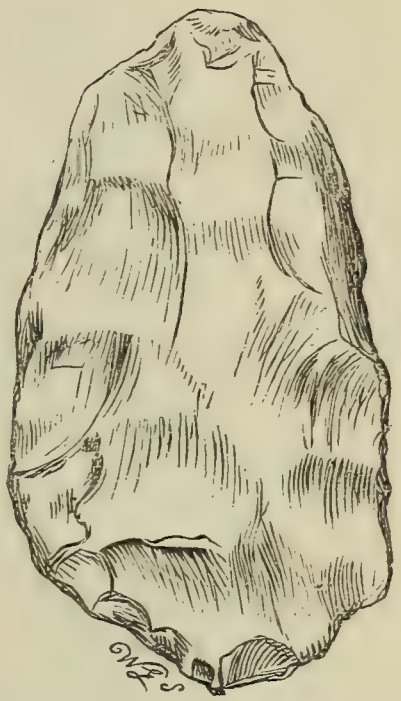


Fig. 9.—Implement of the oldest class.

Another fact must be mentioned here: the men who used the oldest known tools sometimes broke them in two whilst they were at work with them; the accidentally-fractured surfaces of this class are of course as old as the tools, and therefore always ochreous. Points and butt-ends wholly ochreous are of common occurrence: these pieces of tools must have been shattered for long ages before the gravels of middle age were laid down.

The men who made and used the rude ochreous tools were to a great extent a "whole-handed" race—they had not learned the full use of their fingers, but held the weapons as one would now hold a heavy stone for smashing. It is probable that the more pointed end of the club-shaped implements was sometimes grasped in the hand and the butt used as a club or hammer. The absence of scrapers indicates

that the men probably knew nothing of dressing skins, and were unclothed.

The oldest implements, owing to their great amount of abrasion, are often difficult to recognise when they lie in the roads or on heaps of gravel; in fact some are so water-worn and smooth that they look, at first sight, but little different from the unworked natural flints.

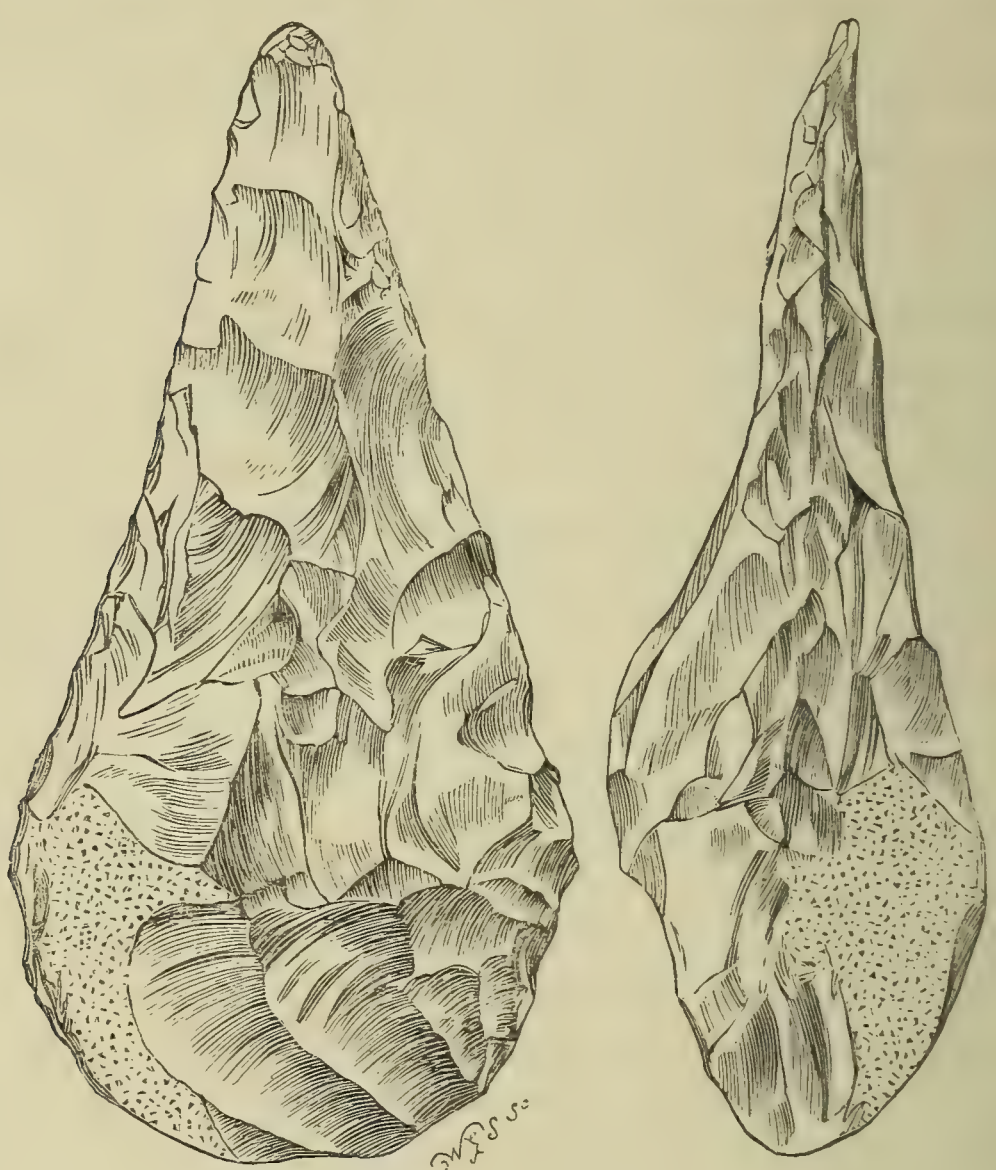


Fig. 10.—Pointed weapon, one half actual size.

In and near London lustrous and subabraded tools of medium age are commonly found at a depth of 12 feet; these tools show a distinct improvement in workmanship over the older ones. Most of the examples are lingulate and sharply acuminate; and the butt, and sometimes the umbo, show signs of hammering; the ovate form is not uncommon, but implements of this age with a cutting edge all round

I have not yet seen. A few chisel-ended implements occur. Rude choppers and somewhat large scraping tools are common. All the artificially-chipped stones of this medium age are subabraded and lustrous. They were not made where now found, but have been carried by the drift for a short distance from the north, or from a higher terrace. A pointed weapon and a chopper of medium Palæolithic age are illustrated half real size at figs. 10 and 11 (formerly Nos. 588 and 482 in my collection, but now in the possession of Mr. John Evans). A scraper from the Thames Valley at Hanwell (No. 9 in collection) is illustrated half real size in fig. 12.

Fig. 11.—Chopping-tool, one half actual size.

The tools when seen in the undisturbed gravel of the Lea are invariably flat, never upright, and the butt or heavy end is often towards the Thames and the point towards the northern position from whence they have been washed. It is rare to find implements *in sitû*, although I have several times so found them.

When the lustrous subabraded tools were made the men had by that time acquired the habit of holding their weapons

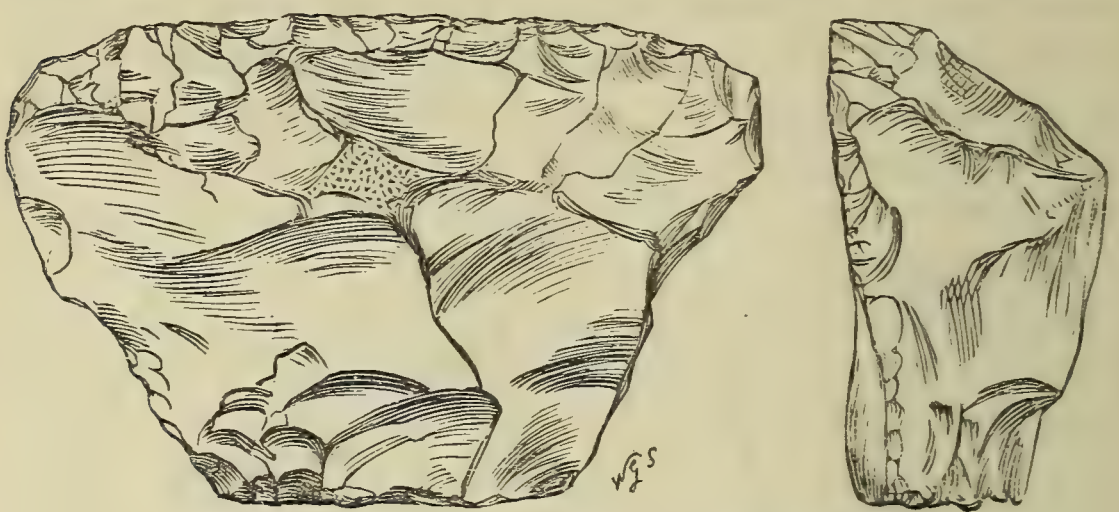


Fig. 12.—Massive Scraper, one half actual size.

Fig. 13.—Unfinished tool, one half actual size.

in a lighter fashion—still in the palm, but more lightly held with the thumb and two next fingers. The frequent presence

of horse-shoe and side scrapers now indicates that the men had possibly learned to rudely dress skins for clothing. Sometimes unfinished implements are found; one of medium age from Lower Clapton, London, is illustrated at fig. 13. The dotted line shows where the point would have been if the maker had finished it. Implements roughly blocked out to form, and without any secondary trimming, are common: it would appear that the men sometimes first blocked out a number of implements rudely with a heavy hammer-stone, and afterwards finished with neater fabricating tools.

An implement in a preparatory stage, of which I have many similar examples, is illustrated at fig. 14, from Acton; this specimen is now in the British Museum, at South Kensington. No doubt these unfinished tools and weapons were often put to makeshift service. Many implements were accidentally shattered in the course of manufacture, and the shattered failures are common in all implementiferous gravels.

Fig. 14.—Implement in a preparatory stage.

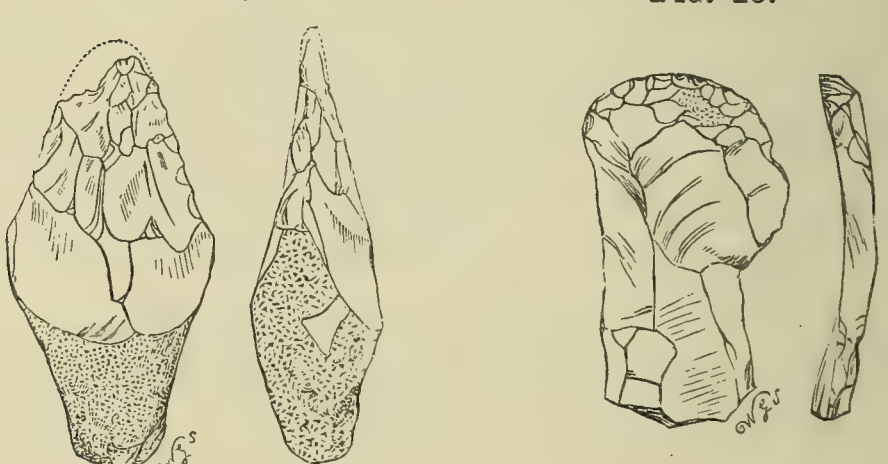
Long after these two classes of tools were buried by floods of water deep in the gravel and sand, there lived a third race of Palæolithic men, as far removed from the men who made the lustrous subabraded implements as these latter men were from the makers of the ochreous and highly-abraded instruments. These newer tools are found at Stoke Newington at about 8 feet above the lustrous examples, and generally about 4 feet beneath the present surface. In some places so much top material has been taken off for brick-making that the stratum containing the newer implements is almost exposed on the surface. Denudation since Palæolithic times has considerably

altered the contours round North London; and the "Palæolithic Floor" at South Hornsey, close to Stoke Newington, is 14 feet below the surface instead of 4 feet—this 10 feet has been removed in some places by the rains of centuries, in others by modern brick-makers and nurserymen.

Fig. 15. Fig. 16.

Pointed implements, one half actual size.

Fig. 17. Fig. 18.



Pointed implement, one half actual size. Scraper, one half actual size.

The newest Palæolithic implements are as a rule not highly lustrous as in the last, but sublustrous, and often even dull; not abraded or subabraded, but as sharp as on the day they were made. As a rule they are very much smaller and lighter than anything belonging to the two previous periods. An example is illustrated half actual size at fig. 15 (No. 403, formerly in my collection, but now in the possession

of Mr. John Evans). Other characteristic specimens are illustrated at figs. 16 and 17. Fig. 16 is a thin and exquisitely manipulated trimmed-flake (No. 47 in my collection), weighing only $1\frac{3}{10}$ ounces. Fig. 17 is an implement worked on both sides, the natural crust of the flint being left untouched on the butt, weight $1\frac{1}{6}$ ounces (No. 627 in my collection). Oval implements with a cutting edge all round now appear; a few examples, as in the last period, occur where the broad end (as in Neolithic celts) appears to have been designed for cutting or chiselling; scrapers are common, not large and rough, but as a rule small and extremely neat. One is illustrated at fig. 18, half actual size (scraper No. 22 in my collection); small knives, *i. e.*, flakes, with the edge or edges showing very neat secondary trimming, are common, and hardly to be distinguished from Neolithic "knives." As a rule every object is now neat, small, and fine.

That these later implements are of a different age from the last is proved by the curious fact that the newer implements are sometimes re-made from older ones, *i. e.*, re-trimmed after the lapse of a vast period of time. I have several such examples, one a scraper belonging to the "Palæolithic Floor": it is made from an old lustrous flake of medium age, all the more recent work being dull and sharp.

The different surfaces — *viz.*, 1, ochreous, and greatly abraded; 2, lustrous and subabraded; and 3, dull and perfectly sharp—point to three periods greatly removed from each other in the Palæolithic age. In some places, as in the loam of Canterbury, the more recent Palæolithic implements are white, but when broken the inner substance is dark grey; the white colour is a bark of decomposition, and this white bark or crust has been acquired since the most recent Palæolithic times. Now Neolithic flints at Canterbury remain blackish grey to the present day; the thousands of years (say from two to ten) since they were chipped have been insufficient to cause even the thinnest conceivable white film of decomposition to appear, but a Palæolithic example from the same place and near the ground surface has acquired

a white bark of a sixteenth of an inch in thickness. How much older, then, must this Palæolithic implement be than the Neolithic flints from the same place. There is other evidence of the extreme antiquity of these things. They are *all* beneath the "trail" and "warp." Now the "trail" belongs to geological time, and the period of its deposition is so remote that one can only guess at its age in years. The newest Palæolithic implements are every one beneath and older than the "trail"; how very much older, then, must be the oldest implements. The proofs that they are really older I have given.

The tools of the later Palæolithic period show a marked development of the hand in the makers, for the chippers of these later tools had learned to hold small instruments with the fingers—much as we now hold a small pen, pencil, or knife. From the rude and heavy bludgeon the men had advanced to beautiful oval and ovate forms, almost perfect in geometrical precision. The progress from the large and rude, to the extremely small and neat scraper, shows that the men had probably progressed in the art of dressing skins, and in every way did finer and neater things. That these men and women now wore necklaces, and possibly bracelets, seems proved by the fact of specimens of *Coscinopora globularis*, D'Orb., occurring with the natural orifice artificially enlarged. I have several specimens thus enlarged from a hoard of more than two hundred examples found together near Bedford. Mr. James Wyatt, F.G.S., noticed a similar fact, as recorded by him in the 'Geologist' for 1862, p. 234. These later Palæolithic men lived in large and probably peaceful companies, and their living-places stretched in unbroken lines on the old river-banks. The "Palæolithic Floors" are not little isolated patches, but places extending for many miles; how large they are it is impossible to say, from paucity of excavations. They are not confined to the Valley of the Thames, but occur in many places.

The newer implements and those of middle age are innate with, and have belonged to, the gravel from the first. The older implements are distinctly "derived," like the cretaceous

fossils commonly found in the gravel. We know whence the fossils have come, because they are so common; the abraded ochreous implements, on the other hand, are very rare, and this rarity makes it difficult to say whence they have been derived; they belong to none of the existing rivers. As in 1868 ('Journal of Anthropological Institute,' Feb., 1879) I recorded my discovery of flakes and implements in the so-called middle glacial gravel of Amwell, Ware, and Hertford, I have little doubt that the older implements have been derived from these positions. Whether the above-mentioned gravels are really glacial or not I am not prepared to decide. How the implements got into the gravel I cannot say. I found them in the ballast thrown out of the pits, and in the pits themselves. If the gravel is glacial, could not glaciers have swept up flakes and tools from old surfaces in the same way as the "trail" has undoubtedly done?

Great caution must be exercised in the acceptance of implements as of glacial age, even if found on the surface of glacial gravels. Men of the later Palæolithic age lived only seven miles south of Ware, and there is no reason why they should not have strayed over those high positions. In fact I believe the Palæolithic men who once lived where the district from Stoke Newington Common to Cheshunt now is, actually did walk over the exposed high gravels of Hertford and Ware, and any implements found on the top of those gravels, instead of proving man to be pre-glacial, would only prove that the most recent post-glacial men strayed over that surface. Implements in two conditions have been met with at Hertford and Ware, one sharp and unabraded, left by the "Palæolithic Floor" men on the surface, others greatly abraded and found in the body of the gravel. Some of the Lea Valley tools show glacial striæ on the original crust, but never on the worked portions.

There is apparently, but perhaps not really, a gap between each of these three Palæolithic periods, as there is apparently a gap between Palæolithic (in its vague general sense) and Neolithic times. Each older period, however, has forms foreshadowing those which follow in succeeding

periods, even down to Neolithic times. No doubt the fossil bones, if a good series could be obtained, would show a succession of, or possibly different groups of, animals in the different deposits; but the bones, antlers, and teeth met with by me are at present insufficient to define any such groups with distinctness.

The day will come when we shall know much more of Palæolithic men than we know now. At present we only know that such men once existed, and made weapons and tools of stone during long periods of time. How or where they first appeared as human creatures we can only guess. When we know more we shall modify our use of such terms as "River Drift Men," "Cave Men," &c., and we shall probably be able to mark out more or less distinctly a succession of men, a succession of geological events, and a distinct succession of progressive steps in the men from the lowest savage to the barbarian. Some of our ignorance is undoubtedly caused by the undue attention which has been bestowed on the collection of ornate implements, and to the employment of gravel-diggers for their collection. No greater mistake can be made than the mere getting together of the more highly-finished and perfect implements. We only learn from them that certain makers—at first few and far between, common at last—acquired extraordinary skill in the manufacture of stone tools and weapons. For one perfect example, twenty have their points, butts, or edges injured either by peaceful or warlike work. Collectors will not put the damaged examples and failures in their "cabinets"; but every damage tells some story of the use of the implement, and throws some light on the character of the being who made and used it.

Implements could not have been made without fabricating-tools—without punches, hammer-stones, and anvils; where the ordinary implements are these latter things also are. Implements such as are seen in museums are only fit for moderately rough work; very rough work was sometimes done, but rough and massive stones artificially worked are seldom seen in collections.

The Valley of the Thames has yielded me between 400 and

500 implements. After my localities were published many other geologists and archæologists sought after these weapons and tools, and now I know of at least 400 other examples in different collections. The smallest and lightest implement

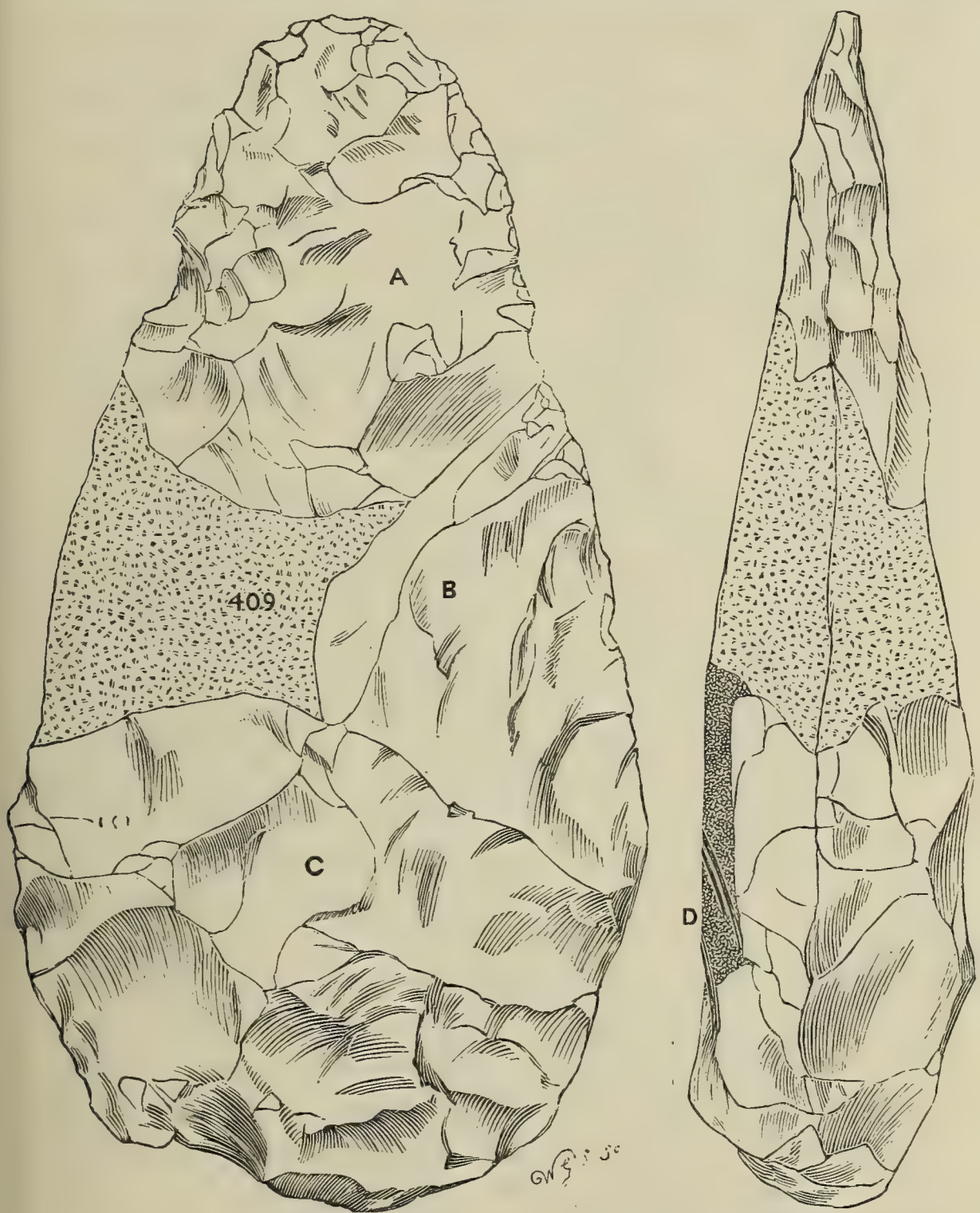


Fig. 19.—Ovate implement, one half actual size.

in my collection is fig. 17. The largest (formerly No. 409 in my collection), now in the collection of Mr. John Evans, measures 9 inches by 5, and weighs 2 pounds $13\frac{3}{4}$ ounces. This implement, here illustrated one half actual size (fig. 19),

exhibits glacial striæ on a large patch of original crust on one side, and indicated at D on edge view. This implement was found on the "Palæolithic Floor" in three pieces, by two different men at different times and in different places. If the report given by the finders is true,—and I have no reason for disbelieving it,—the implement must have been broken in Palæolithic times. The men who found the pieces did not know they would fit together, and the fourth piece, indicated by dots, although sought for, was never found.

The mode of manufacture of these implements seems to be obvious: in the first place, suitable pieces of flint were got together and those which naturally approached an implement-like form were generally selected. The reason for this is clear, for such blocks would be less troublesome to trim to shape, and a smooth butt-end would be ready covered with the natural crust of the flint, and free from inconvenient asperities. It follows, therefore, that many implements are natural blocks of flint cleverly pointed or furnished with artificially made cutting-edges. If suitable natural blocks of flint did not present themselves, then some large block of flint would be "quartered." This was done by impact with a hard tough stone, and the most suitable of the newly-broken pieces of flint were selected for manufacture into tools. The fashioning of the blocks into implements was carried out by striking skilful blows on the edge of the flint, possibly with a tough quartzite pebble. The result of these repeated blows on the edge of the flint block would be that numerous splinters or flakes would fly off from the flint at each impact of the quartzite pebble. Large flakes would be first struck off, and as the implement gradually approached

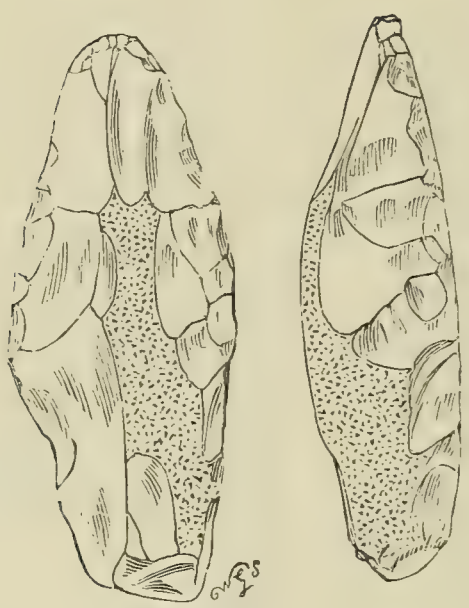


Fig. 20.—Fabricator, one half actual size.

the required form the flakes would become smaller and smaller. The smallest flakes were probably pushed off, as some savages now detach minute flakes by pressure; this could have been done with a canine tooth or a boar's tusk, or a tool known as a "fabricator." Though "fabricators"

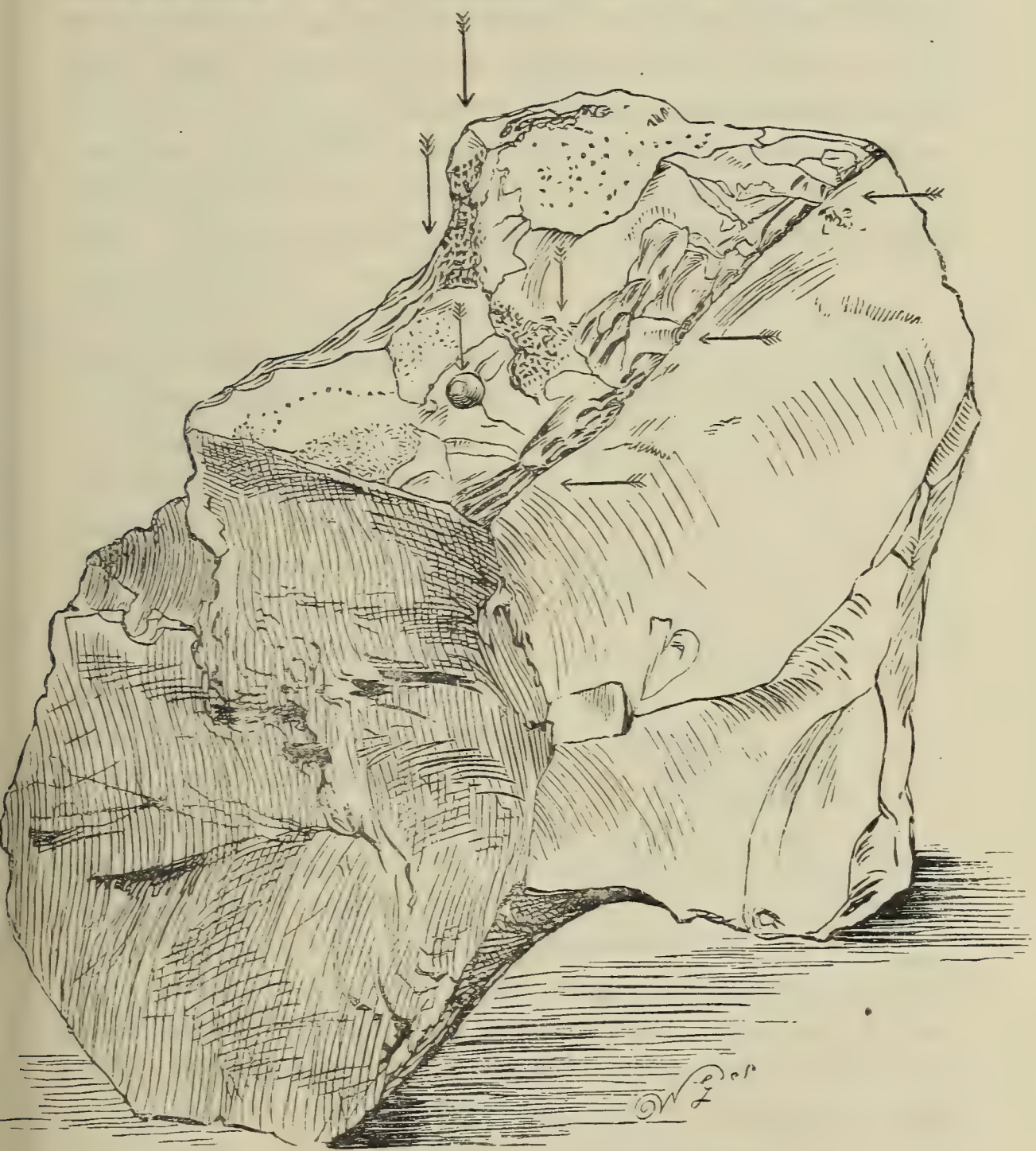


Fig. 21.—Anvil-stone, one half actual size.

are pointed out as Neolithic tools by Mr. John Evans, yet, as far as I know, they have not hitherto been described amongst Palæolithic tools; they, however, occur in the Thames Valley-gravels, and one from Stoke Newington Common is illustrated one half actual size in fig. 20.

Whether the Palæolithic men ever used "anvil-stones," as some persons believe the Neolithic men did, seems uncertain, but my impression is they certainly did. Massive blocks of flint showing distinct marks of hammering are by no means uncommon in Palæolithic gravels. One found by myself on the "Palæolithic Floor" is here illustrated (fig. 21); the vertical arrows show the direction of vertical hammering, and the horizontal arrows the direction of blows delivered on the block in a horizontal direction. With the exception of the bruised and splintered edge seen between the two sets of arrows, all the other edges of the block are sharp. I was present when the block was exposed on the "Floor"; many sharp flakes were found near it, and several quartzite hammer-stones; — that is, quartzite pebbles with the ends abraded off by hammering; one of these pebbles, illustrated half actual size at fig. 22 (formerly No. 18 in my collection), is now in the possession of Mr. John Evans. The dotted parts show where the pebble is abraded away.

Fig. 22.—Quartzite Hammer-stone, one half actual size.

This brings us to the question of what is an artificial flint flake, of which hundreds of thousands exist in the Lea Valley, a hundred or more flakes to every implement. A flake of good character is generally a somewhat thin piece or slice of flint, with several facets on one side and none on the other; the perfectly plain side is furnished at its base with a cone or bulb of percussion, a small conchoidal swelling extending into a conchoidal curve. This cone and its extension to a curve is peculiar to a flint artificially fractured with a round-headed hammer. Outside flakes are very common; these are the first flakes struck from the parent block of flint; one side shows the natural crust, and the other side is

quite plain, with the cone at the base; the cone shows the point of impact of the quartzite pebble used in the hand as a hammer. The plain side of a flake from Stoke Newington Common is illustrated one half actual size at fig. 23; the other side of such a flake may present either the natural crust of the flint, or exhibit a surface with several artificial facets, or it may be trimmed and bevelled all over; the conchoidal swelling or curve projects towards the spectator at A; four distinct cones are seen at B B B B, and at least six points of impact are indicated by the points of the six arrows. These six or more cones prove that the flake was not easily set free with the hammer from the parent block of flint, and that it took six or more consecutive blows for its discharge. Now people who think they disbelieve in flakes say a round tough stone might fall from the top of a high cliff on to a brittle block of flint on the beach below, and set a flake free with a bulb of percussion; or that a glacier might force a round tough stone against a brittle flint with a similar effect. Though improbable, I acknowledge that such phenomena might happen and produce one cone; but who in his senses can imagine the round tough stone going up again to the top of the cliff and falling down again five or six more times on to the same place on the same flint, or a glacier altering its nature and receding five or six times to produce five or six cones closely adjoining each other? Double, triple, and quadruple cones are extremely common, and they distinctly prove that a human hand, directed by a human brain, delivered the successive blows.

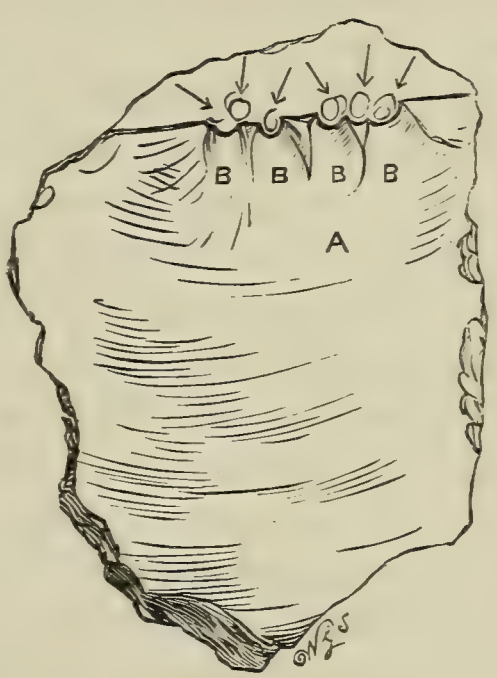


Fig. 23.—Plain side of an artificial flake, one half actual size.

Palæolithic implements were probably never mounted in

handles (and so not resembling Neolithic celts); they were always used in the naked hand; when asperities were present on the flint, the hand was protected in some way, possibly by a piece of hide, or by rushes or other vegetable material. I have an implement with remains of vegetable stems still adherent. The implements were used for anything and everything the primæval men wanted to do—cutting, hacking, and scraping with the edges, piercing and stabbing with the point, and no doubt hammering with the butt, the pointed part being sometimes held in the hand after the style of a hammer-handle. Nothing is more common than to see unquestionable marks of use on implements and flakes. The implements were frequently broken whilst being used as choppers and wedges; this accounts for the occurrence of so many damaged points and butt-ends, and free butts and points. The edges of implements are commonly worn away by use, the result of such use being manifest in a concave depression often of considerable size in the cutting-edge. Flakes, often being naturally knife-like in form, were commonly used as knives for cutting and scraping, and many flakes have a crescent-shaped depression worn out of what was once the keenest part of the edge.

The rougher implements were probably not much esteemed, and possibly little care was taken in their preservation, for as they were often made with twenty blows or less it would not be a very arduous task to make good any losses with new examples. Some of the implements, however, I believe, were greatly prized and carefully preserved; some show such extreme care and manipulative skill in their manufacture that it is impossible to conceive of such objects being lightly esteemed by their makers. Indeed I am inclined to believe that some very large and ornate examples were held as badges of office or as distinguishing marks of some sort of personal superiority or chieftainship in the maker or owner. It is impossible to believe with Prof. Boyd Dawkins ('Early Man,' p. 163) that the Palæolithic men threw their implements away when done with. What were the men to do with their implements when they had finished a job? They had no

boxes, and probably no cupboards or pockets, so they were obliged to put them on the ground, but this was not throwing them away. When the implements were once put on the ground it no doubt often happened that the owners could not find them again, and so they were forced to make new ones. I have not the slightest doubt that I have often picked implements off the "Palæolithic Floor" from the very spot where they were originally laid down by their makers.

I find implements wherever the Lea-gravel is dug, sometimes in the gravel-pits, sometimes on the heaps of ballast outside the pits, but more frequently in newly-gravelled roads. It requires a sharp and experienced eye to find even Palæolithic implements. A good time for an excursion is after heavy rains, when the stones are clean, for in dry summer weather the stones are often so thickly smeared with tenacious clay that it is no easy matter to recognise an implement. Again, when the implements are in the roads they are not always fully exposed to view, inviting the passer-by to pick them up; they are generally so involved with the other stones that only part of a butt-end or side, or possibly a point, is visible; and as all these parts sometimes show a considerable amount of natural bark, to say nothing of dirt, it follows that the seeker after Palæolithic implements should be perfectly familiar with all the forms. In Palæolithic localities flakes are a hundred times more common than perfect implements, therefore these objects are the more likely to be met with; in new positions I always keep a keen outlook for flakes, and if I light on one flake it is a certain proof to me that implements will be found after sufficient searching.

Before I leave the subject of the implements and say a few concluding words regarding the men who made them, I will quote the remark of Sir John Lubbock, who says the implements "speak for themselves." They do indeed speak, and with an unerring voice to those who hear aright. There is not a single implement or flake, but can tell us something of itself, its use, or its maker. What a tale the large implement tells, broken as it was in Palæolithic times, and mended only

last year—what a tale the deep glacial scratches tell on the original crust. One implement seems to say that its maker had light and skilful fingers, and a true eye for a beautiful and correct form. One example seems always to say that it was made by an old man who had made many hundreds of such tools before: the perfection of the manufacture and the dexterity of the flaking prove it. Another seems to say that it was made by a raw beginner, and confesses itself by its form to be a failure, an abortion, and a waster, angrily thrown away as worthless. One big acutely-pointed tool seems to say that it was made specially to attack a Mammoth, a Rhinoceros, a Lion, a Horse, or a Man. Another confesses by its shape to being a domestic tool, made by primæval hands to scrape the flesh from the bones of a Horse, or to prepare a skin for a rude cloak. One says it was used for splitting wood, another for felling a beast; some say they were made for neat work, others for coarse; some for hunting, others for peaceful purposes at home. One tells how it lost its acute point in a desperate contest, or by a provoking accident; another how it lost its edge by long hacking at tough green wood; another tells how its butt-end had been battered by constant hammering: all shadow forth something to the thinking observer.

Although it is easy to suggest the probable uses to which many of the implements were put, yet there remain some forms which defy all explanation; our knowledge at present is so imperfect of the men who made the tools and the mode of life of those men that a ready explanation is hardly to be expected of every object found in association with the ordinary well-defined implements.

Although there is considerable variety of form in Palæolithic implements, and although several new forms have been detected during the last ten years, it is very remarkable that Palæolithic men did not vary their tools more than they did. When the pointed tongue-shaped weapon was invented, and then the oval or ovate tool with a cutting edge all round or with an unworked butt, the men as a rule were unable to proceed beyond the scraper to other forms;

there is no proof that they knew a spear with a handle or an arrow tipped with flint. The fact of these ancient men stopping when they had designed a few useful forms of implements seems to prove that their inventive powers were sluggish.

The age of all the implements must be very great, and it is hardly possible just now to say how great. No one can at present give their age in years, but we can, by comparison with other old things, gain some idea of their immense antiquity. For instance, the architectural remains of Egypt, the temples, the pyramids, and the tombs are generally looked upon as very ancient objects, yet these antiquities are now known to be the works of a civilisation that was at some remote period preceded by a Neolithic age, when the people of Egypt knew no other tools and weapons than such as were made of chipped and polished stone. The recent discoveries of General A. L. Pitt-Rivers, Sir John Lubbock, and other archæologists have decisively proved that even this Neolithic age of Egypt was but as yesterday in comparison with an immeasurably far-off Palæolithic age, when river-side men lived where Egypt now is, and there made their rude tools of the stones of the district. Sir John Lubbock has found an implement of Palæolithic type on the surface in Algeria, whilst General A. L. Pitt-Rivers has found numerous flakes of the same age *in sitû* near Thebes. Some of these objects were found naturally embedded in the walls of indurated gravel forming the tombs, and were there seen in section. Such discoveries were, however, only to be expected when one remembers the quartzite implements of the laterite of Madras. One of my English examples, broken in two, has the impression of a fossil shell in the middle, and this flaw caused the fracture of the implement. Another implement found by me *in sitû* at Clapton has a *Flustra* embedded near the point, and the *Flustra* is exposed by the flaking executed by the primæval men; under the microscope the structure of the *Flustra* is as clear as when the organism was alive. Did the Palæolithic man notice it when he had finished the instrument? How

long is it since this *Flustra* lived in the sea, and particles of silex gathered round it and enclosed its form in this flint? How long since that sea-bottom was upheaved and became a chalky down? How did the glacier or the melting ice break up the chalk and set the flint free for the Palæolithic implement-maker to find? How came the implement when made to be buried under ten feet of gravel, and by what curious chance was it that thousands of years afterwards I walked into that Clapton gravel-pit and saw the implement embedded with the constituent stones of the drift in the pit-side? There is not an implement in my collection but plainly speaks and questions of facts like the above. I could easily occupy a long evening by repeating the things the implements suggest—and not only suggest, but often prove to the careful student.

We have now come to the point where the men themselves must be mentioned; but how can the man be described when we have not even got his bony framework? Prof. W. Boyd Dawkins tells us that the bones of drift-men at present found are insufficient to build up a single skeleton, and I should not be far wrong if I said that up to the present time there has not been a fragment of man's bony fabric that can with positive certainty be referred to man of the River Drift. There is doubt about the authenticity of the osseous relics referred to River Drift man, and uncertainty regarding the circumstances of finding. It must be understood that I do not refer to men of the Caves, but to the far older tribes who lived on the river-margins and others who lived before the present rivers flowed.

We know, then, the primæval men were men as we now understand men to be, men with thinking heads, with correct eyes for beautiful and true forms, and with uncommonly skilful fingers for the difficult task of making ornamental and useful tools out of very intractable materials. We know that they chiefly lived in the open air, on stony river-banks, and that they picked up the stones at their feet wherewith to make their weapons and tools. We know that primæval man lived in company with the Mammoth,

Hippopotamus, Rhinoceros, Bison, Lion, Hyæna, Horse, Reindeer, Irish Elk, and other animals, that he probably hunted these animals, and lived upon the flesh of some of them. The drift-men must have been safer and freer from surprise on the river-banks; they could not venture far into woody places without danger from savage beasts. We know that primæval man had no domestic animals—no dog, no sheep, no goat, no domestic ox. A description of all the animals that lived with primæval man would be beyond the province of this paper, but every member of the Club knows what has been done in this direction by Sir Antonio Brady and other geologists. The brick-earths of Ilford and Clapton have also been studied by Dr. W. Martin Cooke, and examples of the bones both from Ilford and Clapton are now deposited in the British Museum, with other Essex specimens from Clacton-on-Sea and Grays Thurrock.

We know that Palæolithic men were unacquainted with agriculture; so after the flesh of beasts we may reasonably assume that the men consumed the wild apple, pear, sloe, and possibly the fruit of the oak, hazel, and beech, with other wild fruits and succulent roots. They probably knew the use of and mode of procuring fire, but their wood could seldom have been very dry. Whether they used missiles or not for throwing is not proved: they did not mount their weapons. The sling is doubtful, and the bow was probably unknown. My impression is, the men sometimes used meta-tarsal bones of horses and animals of a like build for clubs; a number of these bones have been more than once found in company in the Lea Valley; they probably used suitable branches of trees as natural clubs also. That primæval men were fierce and strong is probable, but they undoubtedly had friendship for each other, as they lived in large companies. That they had an idea of ornament is proved by their beautifully formed implements, and by the use they probably made of the bead-like *Coscinopora globularis*.

Our knowledge, however, of primæval man, as a man, is at present a mere shadow. Still we are as certain of his former existence as we are of our present existence, but we cannot

at this time accurately define his mental and bodily outline. At times there is a slight flicker of new light—too often, it must be confessed, a light that speedily dies out, or is proved to be delusive. New facts about primæval man come in very slowly, but the time will one day certainly arrive when we shall be able to place his bones together. In times like these it is necessary to remember that we require nothing but facts —we want the truth. No idle fancies, or highly coloured or erroneous statements, are wanted. Palæolithic man has quite recently been described in a popular scientific periodical as a low-browed, flat-headed, dog-jawed, black-skinned, hog-tusked, short-legged savage, worse in type than the lowest savage of the present day—in other words, an animal more repulsive than a baboon. The same writer instructed us that, after the river-drift and cave implements were made, Northern Europe was submerged for many hundred feet under the sea and then came up again. These statements regarding the men are sensational libels, having no foundation in fact. I admit that we may have had a demon-like progenitor of the baboon class in the long past, but that was long before the time of the men of the river-gravels, and vastly longer before the time of the skilful and artistic Palæolithic cave-dwellers. No doubt the river-drift men were different from the men of modern times; probably they differed somewhat in colour, form, and hairiness; but as modern Elephants, Lions, Hyænas, Horses, and other beasts do not enormously differ in form and character from the allied animals of the river-gravels, why should modern man differ from the river-drift man in an enormous degree?

It need hardly be said that the river-drift men had no written language; they lived a very long time before any cup-marking or ogham lines and notches were thought of; yet these men must have had some means of expressing their passions and thoughts, chiefly, perhaps, by a few partially-articulate sounds and significant gestures.

Primæval man lived in vast numbers on the banks of the Lea; he also certainly lived in South Essex on the northern banks of the Thames, and, as I have shown, in the Valley of

the Roding. It is now extremely desirable that the other river-valleys of Essex should be well searched, and I commend this work to the members of the Essex Field Club. It would be well if some member would prove whether primæval man certainly lived on the banks of the Stour—it is probable, for one or two implements have been found in a gravel-pit at Milford Junction on the Great Eastern Railway. Then there is the Blackwater River; the Crouch; the Colne, near Colchester; the Chelmer; and numerous affluents of the larger rivers. With the exception of the south-west corner, and part of the east and south side, the whole county of Essex invites exploration. The implements are abundant in the bordering counties of Suffolk, Middlesex, Hertfordshire, and Cambridgeshire. There appears therefore to be a rich field for research in Essex, and if the implements are not ultimately found all over the county it will, I believe, be more the fault of the members of this Club than the county itself.

We must now leave the contemplation of primæval man and his works in the Lea Valley. After the Palæolithic men had passed away, tribes of Neolithic men lived here—men who not only chipped but sometimes polished their weapons and tools of stone. Before these men arrived, however, the configuration of Europe had changed from what it was as described at the beginning of this paper to what we now know it to be. In other words, Britain became severed from the Continent by the encroachment of the sea at the Straits of Dover, and the old coast-line was entirely submerged. The Isle of Wight was severed by the Solent Sea, and Ireland by St. George's Channel and the Irish Sea. For the last 2000 years changes of level have been unimportant. Whether the Neolithic men were the direct descendants, through the cave-men, of the River Drift men, or whether the Neolithic men came direct from some other stock, is uncertain. It is, however, no part of our purpose to consider the men of Neolithic times this evening, so we may summarily dismiss them with the statement that they lived (amongst other places) in large numbers on the banks of the Lea as we now

see it. The alluvium of the Lea Valley has not been seriously disturbed since Neolithic times, neither have the levels been materially altered. The climatal conditions have of course been quite different from what they were in Palæolithic times; the river has not run in historic times as a rapid shallow torrent laden with blocks of ice and large stones as it did in Palæolithic times. It is now a quiet stream, with no power to bring down huge stones and uncountable tons of gravel; neither has it the power now

Fig. 24.—Three Neolithic Celts, found near Temple Mills, Essex.

to excavate the valley as before. The Thames itself has not excavated its valley near London since the Neolithic period, say for 2000 years. If the changes from Palæolithic times to now have been gradual, as all the evidence seems to show, and if in 2000 years, or from 2000 to 10,000, no great change has taken place in the levels, how immensely far off the time seems to be when the level of the Thames was at least 160 or 170 feet higher than at present. How enormous

must the required time be for the excavation of such a valley. Yet before that distant time, man lived close to where London now is. As a proof that the levels have not changed in the Valley of the Lea since Neolithic times, I exhibit this evening three superb wholly-polished flint celts from my own collection (now in the collection of Mr. John Evans), fig. 24, found just under the alluvium at Temple Mills, near Stratford, a few weeks ago. The celts were found side by side and touching each other; they could not have got into such a position by accident, but were clearly so placed by their Neolithic owner. These three exquisitely-made celts, their edges still so keen that it is impossible to imagine that they could ever have been used, were probably the stock-in-trade of some Neolithic man; he carefully placed them on the ground side by side, and never returned to re-possess himself of them; the dust and a few inches of surface-earth accumulated upon them, and they remained on the spot where the former owner laid them down at Temple Mills till a week or two ago.

The Bronze Age is represented in the British Museum at Bloomsbury by bronze implements found at Walthamstow; and in the Anthropological Collection of Gen. A. L. Pitt-Rivers, now at South Kensington, may be seen numerous implements made of bone from the Walthamstow peat.

When we speak of the Roman Conquest we refer to comparatively modern times; relics of that period in coins and pottery are frequent in the Valley of the Lea, especially about Leyton and Stratford. Saxon, Danish, and Norman antiquities are also commonly met with, and these objects foreshadow our own times.

VII.

On the Species of the Genus Primula in Essex; with Observations on their Variation and Distribution, and the Relative Number and Fertility in Nature of the Two Forms of Flower.

By Robert Miller Christy.

[Read October 28th, 1882; revised Spring, 1883.]

" . . . . Pale Primroses
That die unmarried, ere they can behold
Bright Phœbus in his strength. . . .
. . . Bold Oxlips."—*The Winter's Tale, Act IV.*

I.—Introductory Remarks.

During the last six or seven years I have interested myself more or less in observing and collecting the numerous forms and varieties into which our common British Primulas so freely enter; and as during part of that period I have lived in the one small English locality in which alone grows the true *Primula elatior* of Jacquin (and that in the greatest abundance), I trust a few remarks on this singularly interesting genus of plants will prove of some value.

A careful study of Mr. Darwin's work, 'The Different Forms of Flowers on Plants of the same Species,' has, moreover, led me to pay special attention to several points in the Natural History of the various members of the genus *Primula*, and it is also with the intention of giving my observations on these phenomena that I write this paper. All the references given hereafter are to the above-mentioned work, unless otherwise stated.

Mr. Darwin very truly remarks that "The claim of the three forms [*Primula vulgaris*, *veris*, and *elatior*] to rank as distinct species has been discussed oftener and at greater

length than that of almost any other plant." Various reasons will account for the interest attaching to these species, among which may be mentioned their "heterostylism," their near relation to one another, the frequency with which they hybridise, their great tendency to variation in several directions, the ease with which they may be brought under cultivation, and, lastly, the fact of their flowering at an early period of the year when few other species are in bloom. Most gardeners cherish some species or variety belonging to this genus, whether it bear the name of "Primula," Polyanthus, Auricula, Cowslip, Primrose, or Oxlip; whilst the numerous paragraphs appearing from time to time in the botanical journals, recording some strange sport or variation, all testify to the general interest taken in the subject.

In spite, however, of the attention which has been bestowed on the Primulas, there are few plants in this country which have been so long and so persistently confused and confounded, one species with another, and this in spite of the publication in 1877 of the 'Forms of Flowers,' which treats of the subject in a most complete and masterly manner. Half a century ago, before so much was known not only of the genus *Primula* itself, but of botanical science in general, this was to a large extent excusable; but there are, even at the present day, numbers of persons who still hopelessly confuse them.[1]

In order, therefore, that I may be clearly understood from the outset, I wish to state that in this paper I am concerned with *three true and distinct species*, which are as follows:—

(1.) The Common Primrose: *Primula vulgaris*, Hudson.[2]

(2.) The True, Bardfield, or Jacquin's Oxlip: *Primula*

[1] I do not, of course, here allude to botanists, but to the general public, who, as I know but too well from personal experience, still invariably confound the hybrid oxlip (*Primula veri-vulgaris*) with the true oxlip (*P. elatior*, Jacq.), even in the district where the latter grows wild.

[2] I have adopted this specific name in spite of a friendly protest from Prof. Boulger in favour of the Linnean one, *acaulis*, which has the priority, but, as Darwin uses *vulgaris*, I sin in good company and with my eyes open.

elatior, Jacq. (but not of Linné), called by more than one local name in Essex, as I shall presently show; and

(3.) The Common Cowslip: *Primula veris*, Linn.; known in Essex and various other parts of England as the "Paigle."

I have not thought it necessary to introduce here arguments in favour of the specific distinctness of these three forms, as Mr. Darwin has so completely thrashed out the matter, and I most fully agree with his conclusions.[3]

In addition to these I shall have to speak of three other *forms*:—

(a.) The Umbellate Primrose, *Primula vulgaris*, var. *caulescens*, Babington, which differs from the true primrose in nothing except that the pedicels are supported on a raised peduncle.[4]

(b.) The Hybrid Oxlip, *Primula veri-vulgaris*, which has frequently been called *P. elatior*, but from which it is totally distinct. This includes all the numerous hybrid productions, bearing flowers in umbels or otherwise, and connecting the primrose and the cowslip, excepting only the form last mentioned as a variety of the former species. According to Dr. Boswell-Syme, in the 'English Botany' (where it is styled "*P. officinali-vulgaris*"), it has been given at different times and by different authors the following names:—"*Primula elatior*"; "*P. variabilis*"; "*P. brevistyla*"; "*P. intricata*"; "*P. thomasinii*"; and "*P. vulgaris*, var. β."

(c.) The Hybrid Elatior, *Primula elatiori-vulgaris*, which, as I hope shortly to prove, is a hybrid between the true Jacquin's oxlip and the common primrose. I believe it has previously been met with on the Continent, but not in England.[5]

[3] 'Forms of Flowers,' pp. 60, 70, 71, &c.

[4] I have distinguished this from the ordinary variable hybrid oxlip, which comes next, on the authority of Prof. Boulger; but personally I have observed little or nothing to lead me to make this distinction, and I do not think Darwin did so.

[5] Now that this form is known to occur in Britain, it will be very necessary to guard against confusing it with the old "hybrid oxlip" (*P. veri-vulgaris*), to which name it is perhaps most rightly entitled, being both an *oxlip* and a *hybrid;* but that name having been already appropriated, I shall call it the "Hybrid Elatior." I have also some grounds for believing that *P. elatior* occasionally hybridises with *P. veris* in Essex.

I shall also introduce observations corroborative of the facts brought forward, made on various other species of *Primula;* but the foregoing are, so far as I am aware, the only forms inhabiting the County of Essex.

I have to express my thanks to the late Mr. G. S. Gibson, to Prof. Boulger, Mr. J. G. Baker, Rev. W. W. Newbould, Mr. Rosling, Mr. William Cole, and other friends, for assistance which they have kindly rendered to me in various ways.

II.—The Phenomena of "Heterostylism" in the Genus Primula.

All botanists are aware that our British species of *Primula*, and indeed most members of the genus, bear dimorphic heterostyled flowers; but as a good deal that I shall hereafter say will be upon this subject of heterostylism, and as

Fig. 1.—Vertical sections of, *a*, long-styled, and *b*, short-styled Primrose. [From Dr. Hooker's 'Primer of Botany,' by kind permission of Messrs. Macmillan & Co.]

some who read these remarks may desire to have more fully before them a description of this interesting peculiarity, I have thought it best to append a brief summary of what is known concerning its nature and effects.

In most species of *Primula* there are *two forms of flowers differing principally in the length of the style*, or, to speak more correctly, in the relative position of the anthers and the stigma. This is the most obvious difference, but there are others of but little less importance. In the *long-styled* or "Pin-eyed" form (fig. 1 *a*), the style is sufficiently long to support the stigma at the top of, or entrance to, the tube of the corolla. The stigma is globular and very rough, being

thickly covered with short bristles or papillæ. The anthers are attached to the sides of the tube about half-way up, and the tube enlarges itself slightly above them. They contain pollen of an opaque nature and oblong form. A single grain of cowslip pollen, according to Darwin's measurement,[6] is 25·400 μ long; according to Mr. Bennett,[7] it is 25·400 μ long by 12·700 μ broad; pollen from the long-styled form of the primrose, as given by the same authority, is 22·860 μ by 12·700 μ, but some which Mr. Rosling has been kind enough to measure was 25·400 μ long; Mr. Rosling has also found pollen from the same form of *P. elatior* to measure 22·860 μ in length by 15·240 μ in breadth.

In the *short-styled* or "Thrum-eyed" form (fig. 1 *b*), the style is only sufficiently long to support the stigma at about half the height of the tube, or almost exactly in the same position that is occupied by the anthers in the other form. The stigma itself is broader, more depressed, and much smoother. The anthers are of the same size as in the long-styled form, but are affixed to the sides of the corolla-tube at its top or only just within the entrance. The pollen they contain is larger, more transparent, and almost spherical. Some short-styled cowslip-pollen which Darwin measured was 36·285–39·914 μ long, thus comparing with the other form as 100 to 67. According to Mr. Bennett's measurement it is 35·560 μ by 25·400 μ. The same authority states that pollen from the same form of the primrose is 30·480 μ by 19·050 μ, and some which Mr. Rosling measured proved to be 35·560 μ long. Mr. Rosling finds that the pollen of the short-styled form of the oxlip is 35·560 μ long by 20·320 μ broad. The pollen of these three species is seen to be much alike when examined under the microscope, being, as Mr. Bennett says, "shortly cylindrical rather than ellipsoid." Mr. Rosling, Mr. Bennett, and myself have all observed that the number of longitudinal furrows with which the grains are marked is variable. The unfertilised ovules of the short-styled form are smaller than those of the long-styled form.

There is no difference whatever to be observed in the two forms as regards the leaves, root, or "habit" of the plant,

[6] [We have reduced all these measurements, which were given in discordant fractions of an inch by the several observers, to *micromillimetres* (= μ; 1000 μ = 1 millimetre), in accordance with the simple metric system now adopted by the Royal Microscopical Society. It is to be hoped that all microscopical observers will use the system, and so render their micrometer measurements comparable one with another. It will be adopted in the future in these 'Transactions.'—Ed.]

[7] 'Popular Science Review,' April, 1875, p. 113.

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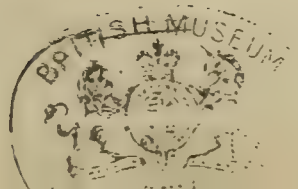
nor in the size, shape, or colour of the calyx or corolla, except that the tube of the latter accommodates itself slightly to suit the difference in the position of the anthers. It is probable that the two forms never appear on the same plant (although this is stated to have occurred in one locality), and the plants invariably bear, year after year, flowers of the same form. Although there are two forms of flowers, each form is hermaphrodite—*i. e.*, it possesses both male and female organs.

The heterostylism of the Cowslip was first noticed by Perzoon in 1794,[8] but for many years it was disregarded as an accidental phenomenon, until Mr. Darwin came with his keen observation and untiring energy to enquire into the matter. He showed in a paper read before the Linnean Society,[9] and more fully in his 'Forms of Flowers' (1877), that heterostylism is one of the most curious and interesting of all the many contrivances by which *cross-fertilization* is ensured in the vegetable kingdom. His first idea was that Primulas were on their way to become dicœcious—that the long-styled flower with its prominent stigma was the most feminine form, and the short-styled flower with its prominent anthers was the most masculine form; but the discovery that the short-styled flowers were actually the most fertile upset this idea. On making experiments he found that the two forms require a *reciprocal union* to ensure full fertility; or in other words, that a flower, say of the long-styled form, is very largely sterile when fertilized with pollen from another flower of the same form (a union which he calls "illegitimate"), but produces its full complement of healthy seeds when fertilized with pollen from a short-styled blossom ("legitimate" union) and *vice versa*. Darwin shows that if a bee visits a short-styled primrose flower it dusts its proboscis with pollen near the base. If then it goes to flowers of the same plant, or flowers on another plant of the same form, no pollen is deposited on the stigmas: on the contrary, more will, in all probability, attach itself to the insect's proboscis; but if the bee visits some flowers on a plant of the opposite form, pollen is (as required) placed at once on the stigma, because that part of the bee's proboscis which touches the anthers in one case touches the stigma in the other, and thus is reciprocal cross-fertilization effected. Were the anthers and stigma placed on the same level, the flowers would more likely than not be *self-fertilized;* and this Darwin has shown

[8] 'Forms of Flowers,' p. 14.

[9] Proc. Linn. Soc. (Bot.), vol. vi. (1862), p. 77, and vol. x. (1869), p. 393.



(in his 'Effects of Cross and Self-Fertilization in the Vegetable Kingdom') is a method which Nature takes every precaution to prevent, and only resorts to it when cross-fertilization fails to be effected. Even if some pollen gets on to the stigma of its own flower (or, in plants like Primulas on a flower of its own form), no perfect, and certainly no immediate, fertilizing action takes place; and if, twenty-four hours after, pollen from another plant (or in Primulas, from a plant of the opposite form) be placed upon the stigma, it at once obliterates all traces of the action of the first pollen, and fertilizes the ovules in a "legitimate" manner. The two forms are very constant. Darwin says:—"I have examined a large number of flowers . . . . . and have never met with any transitional states between the two forms in plants growing in a state of Nature. There is never the slightest doubt under which form a plant ought to be classed."[10] As will be seen in the next section of this paper, I also have examined a very large number of plants, and must beg leave to differ a little from Mr. Darwin on this point. I have met with a few equal-styled flowers, although I have seen nothing like the specimens Herr Breitenbach observed in Germany.[11] Among other extraordinary plants, he met with two bearing equal-, short-, and long-styled flowers. In this case some most unusual disturbing element must have been at work, which, as my tables of observations will hereafter show, does not exist in Essex; and, like Mr. Darwin, I have heard of no other such case in Nature. Out of at least 13,200 *Primula* flowers examined, I have only met with forty flowers which could be described as equal-styled. I do not attach much importance to these, regarding them as due to imperfect development of the style, rather than as a reversion to any original state—indeed I suppose that, strictly speaking, they were not equal-styled at all, for, instead of having the anthers and stigma both on the same level at the top of the tube as should have been the case if truly equal-styled, they had the anthers half-way up, as in the long-styled form, while the stigma (which often showed signs of imperfection) was generally about on a level with them. Reference to the Tables given in the next section will afford further information concerning these flowers. Equal-stylism seems to appear more frequently in cultivated plants than among wild ones. My friend, Mr. Richardson, of Newcastle, found one Primrose plant bearing twenty-one long-styled flowers, and thirteen blossoms that

[10] 'Forms of Flowers,' p. 17.

[11] Ibid., p. 34.

were equal-styled through deformity of the style. On one occasion, when over five per cent. of all the Primroses gathered were equal-styled, a very severe frost had occurred about a fortnight before, which probably had checked the development of the pistil. The stigmas were unusually small. It was noticeable that the stigmas of other flowers on those plants of *P. elatior* which bore any equal-styled flowers were variable in length. All the foregoing instances may, I think, be regarded as long-styled flowers with imperfectly developed styles; and as my first observation on the Cowslip, which gave 2·2 per cent. as equal-styled, was made as early in the year as March 29th, 1882, when very few were out, it is possible that some of these might ultimately have become normal. I have heard of cases, but never saw one, in which cultivated Primroses, properly short-styled, have become equal-styled from another cause, namely, imperfect development of the tube of the corolla. Thus it may be seen how constant this heterostylism is; neither Mr. Darwin nor myself, after an examination of an enormous number of wild *Primula* flowers, being conscious of ever having met with a truly equal-styled one.[12] Nevertheless the length of the style is variable to a certain extent, especially, I believe, in the flowers of the long-styled form, and even in the same umbel. Thus I have seen the stigma in three flowers on one umbel to project as much as one-fifth of an inch, which is not unusual, and often the stigma is as far within the tube. I have also not unfrequently seen the stigma of unopened buds projecting one-eighth of an inch beyond the tips of the teeth of the calyx.

In the spring of 1882 the idea occurred to me to enquire how early in the development of the bud heterostylism exists. I therefore procured some very young buds of *P. elatior* and *P. vulgaris*, and, dividing them longitudinally, I found that in the very youngest, in which not a vestige of the petals appeared externally, the two forms were totally indistinguishable unless it were by some microscopic difference. The anthers seemed to reach their full size and to become of a bright orange-colour long before the bud opened; they were attached to the petals slightly above the ovary. The petals were quite rudimentary and almost devoid of colour, much

[12] If I may trust my memory, some specimens of *P. farinosa* which I gathered in the Alps were truly equal-styled, the stigma appearing with the anthers at the top of the tubes. If so, they were of singular interest, as I never met with such a case in any other species. Mr. Scott says (Proc. Linn. Soc. (1864), vol. viii., p. 115) that it is not uncommon for this species to be equal-styled.

veined, and so short that their tips scarcely protruded beyond those of the anthers. The ovary containing the ovules seemed at this period to be fairly well developed. The stigma was very small, and supported on a short style at about half the height of the anthers. This description applies equally to both forms. Gradually, however, as the flower developed the pistil of the long-styled form gained on, and at last passed, the anthers; while in the short-styled form the corolla-tube grew, raising the anthers far above the pistil, until the normal state was reached.

There is one very important problem connected with heterostylism on which scarcely any information is as yet obtainable. I refer to the transmission of its own form, or otherwise, by the seed of any plant. Experiments on this point are somewhat difficult to carry out owing to the time required for the investigation, as Primulas do not often flower the first year. The very meagre information which Mr. Darwin gives on this point seems to have been collected from various experiments on other matters which he had in hand. He shows that an "illegitimate" union produces offspring almost entirely of its own form, and adds (*loc. cit.*, p. 268):—"The transmission of the two forms by heterostyled plants may perhaps be found hereafter to throw some light on their manner of development." I am glad therefore to be able to announce that our member, Mr. E. Rosling, of Chelmsford, has undertaken to conduct experiments on the point, in the hope of arriving at some definite results.[13]

[13] Note on *Primula longiflora*.—There seems to be some slight doubt (*vide* 'Forms of Flowers,' p. 50) as to whether this species is heterostyled or not. Having met with it this summer (1882) on the summit of the Hill Marmoré in the Engadine, I am in a position to say with certainty that it is *homostyled*, although very variable in the length of its pistil. In this extraordinary member of the genus the corolla-tube is generally 0·9 inch long, so that it is difficult to imagine any insect attempting to reach the nectary. In withering, the corolla does not fall off, but bends at the top of the calyx and hangs down. The edge of the entrance to the tube is marked by a sharp ridge, immediately below which are the anthers, the pistil projecting generally one-fourth of an inch at least beyond them, although it is very variable in length, even in flowers on the same umbel. Thus out of seventy-two umbels which I examined, sixty-seven were truly homostyled. Of the rest, one seemed to be equal-styled, and four seemed to be short-styled; this difference being almost invariably brought about by non-development of the pistil, as in the case with the other species. For instance, one umbel had one flower with the stigma above the anthers, a second with it on the same level, a third with it just below, and a fourth with it *far* below; while the fifth flower had its tube only half the usual length, and the stigma projecting far beyond it. Another umbel bore three ordinary flowers, and two with the stigma below the anthers. Yet another umbel had the stigmas at many

III.—The Relative Numbers of the Two Forms in Nature.

Mr. Darwin has stated[14] that "the two forms exist in a wild state in about equal numbers"; but, from my observations, I shall, I think, be able to prove that this is not the case—there being a considerably larger number of *long-styled* plants than of short-styled ones. The above statement is made whilst treating of the Cowslip, but I presume that it may be taken to refer also to the other species of *Primula*. It is a little curious (although I regard it as a mere coincidence) that all the particulars on this point actually given by Darwin point to a conclusion differing from the results of my own observations; but as I have counted far more plants than he, and as this is a matter of fact and not of opinion, I venture to claim an ability to prove my case. For instance, he says of the Cowslip,[15] "I collected 522 umbels from plants growing in several stations, taking a single umbel from each plant; and 241 were long-styled and 281 short-styled," or as 86 to 100. Of the Primrose he says,[16] "Mr. Scott examined 100 plants growing near Edinburgh, and found 44 to be long-styled and 56 short-styled; I took by chance 79 plants in Kent, of which 39 were long-styled and 40 short-styled; so that the two lots together consisted of 83 long-styled and 96 short-styled," or as 86 to 100. He also quotes an authority[17] who counted 29 hybrid Oxlips in Surrey, of which 13 were long-styled and 16 short-styled, or as 81 to 100. My own observations here follow in detail. My plan of operations was very simple: I merely gathered a single flower or a single umbel from each plant, and afterwards counted them.

different heights; and I noticed more than one umbel on which there were both ordinary flowers and other flowers which were normal in every respect, except that the stigma was not raised more than one-eighth of an inch above the ovary. This great variability in the length of style seems to indicate that the plant is a little inclined towards heterostylism. [Müller also states ('Die Befruchtung der Blumen') that *P. longiflora* is homostylic, and adapted by its long narrow corolla-tube for fertilization by Lepidoptera. The tube is 16 to 24 mm. long, and the nectar is, therefore, accessible only to *Macroglossa stellatarum* (with proboscis 25 to 28 mm. long), and to *Deilephila euporbiæ* (25 mm.) among all the Alpine Lepidoptera.—Ed.]

[14] 'Forms of Flowers,' p. 18. [15] Ibid., p. 18. [16] Ibid., p. 34. [17] Ibid., p. 70.

The arrangement of the tables will, I think, be sufficiently plain without any explanation.[18]

An examination of Table I. shows that, out of 1639 Primrose plants observed on twenty-two different occasions between January 22nd, 1882, and May 1st, 1883, in different localities in Essex and Kent, 758 proved to be short-, 872 long-, and 9 equal-styled, or a majority altogether of 114 for the l. On eight of these occasions, however, the s. had the majority, but only of 45 out of a total of 299 plants observed; while on the remaining fourteen occasions the l. had a majority of 159 out of 1340 plants examined. On the eight occasions when the s. secured the majority the proportion, when compared with 100, varied between 214 and 111—a great divergence. On those fourteen occasions when the l. had the majority the proportion, when compared with 100, varied between 68 and 93. Taking all the observations together we find that the average proportion in which the s. stand to the l. is as 87 to 100. The observations, however, show a great diversity, one from the other, for which I am wholly unable to account. At first I imagined that the situation in which the plants grew—whether under cover or in the open—had something to do with it, but now that I have worked out the results I cannot trace any such effect. The three first observations in 1882 and the first one in 1883 seem to show that the *short*-styled rather than the long-styled plants flower first, but they were made on too few plants to be reliable.

Table II. shows that of 6482 plants of *P. elatior* observed on thirty-four different occasions between March 12th, 1882, and April 30th, 1883, in various localities in N.W. Essex, 2795 were short, 3668 long, and 19 equal-styled, thus giving the l. a majority of 873. On five of these occasions, however, the s. had a majority, but only of 21 out of 613 plants examined, the relative proportions between the two forms in these cases ranging between 104 and 117 as compared with 100. In the remaining twenty-nine cases the l. had an aggregate majority of no less than 894 out of 5869 plants,

[18] [For the sake of brevity we shall frequently print "s." for "short-styled plants," and "l." for "long-styled plants" in the tables and text.—Ed.]

TABLE I.—THE PRIMROSE.

No. of Expt.	Date. 1882.	Locality and Situation.	No. of plants examined.	s.	l.	Majority for s.	Majority for l.	Proportion.	Remarks.
1.	Jan. 22.	Wood (C.*) near Chesterford	22	15	7	8	—	214 : 100	
2.	Feb. 5.	Garden, Chignal	62	27	35	—	8	77 : 100	Every plant examined.
3.	Feb. 5.	Wood, Chignal	11	7	4	3	—	175 : 100	
4.	Mar. 23.	Westley Wd. (G.*), & Grim's Ditch Wd. (C.), Saffron Walden	146	62	84	—	22	74 : 100	Flowers just in perfection.
5.	Apr. 23.	Westley Wood, Saffron Walden	140	58	82	—	24	71 : 100	
6.	Apr. 24.	Garnett's W. (partly G.), near Dunmow	62	26	36	—	10	72 : 100	
7.	Apr. 27.	Overgrown ditch, Chignal	53	32	21	11	—	152 : 100	All flowers in the ditch were examined.
8.	Apr. 27.	Another do.	106	51	55	—	4	93 : 100	All flowers in the ditch were examined.
9.	Apr. 29.	Wood (C.), Chignal	94	42	52	—	10	81 : 100	
10.	May 2.	"The Keep," Plesbey	243	107	136	—	29	79 : 100	
11.	May 4.	Wood (C.) at Laindon Hills	57	23	34	—	11	68 : 100	
12.	May 4.	Roadside bank outside do.	20	13	7	6	—	186 : 100	
13.	May 5.	Ditches, hedgebanks, &c., Chignal	74	40	34	6	—	118 : 100	
14.	May 5.	Same as No. 9	59	32	27	5	—	119 : 100	
15.	May 11.	Hedgebank, St. Mary Cray, Kent	16	7	9	—	2	78 : 100	
16.	May 11.	Wood (C.) at Chelsfield, Kent	164	75	88	—	12	85 : 100	1 equal-styled.
17.	Oct. 2. 1883.	Same as No. 9	35	16	19	—	3	84 : 100	
18.	Mar. 4.	Westley Wood (C.)	38	20	18	2	—	111 : 100	
19.	Mar. 20.	Ditch, Chignal	23	10	12	—	2	83 : 100	1 equal-styled.
20.	Mar. 29.	Wood, Chignal (G.)	22	13	9	4	—	144 : 100	
21.	Mar. 29.	Do. (C.)	123	54	62	—	8	87 : 100	7 equal-styled.
22.	May 1.	Hyde Wood (C.), Lt. Yeldham	69	28	41	—	13	68 : 100	
22.		Totals....	1639	758	872	8	14	87 : 100	9 equal-styled.

TABLE II.—THE OXLIP.

No. of Expt.	Date. 1882.	Locality and Situation.	No. of plants examined.	s.	l.	Majority for s.	Majority for l.	Proportion.	Remarks.
1.	Mar. 12.	Monk's Hall W. (both C. & G.), S. Walden	231	120	111	9	—	108 : 100	Just come into flower.
2.	Mar. 17.	Pounce W. (both C. & G.), S. Walden	55	25	30	—	5	83 : 100	Just come into flower.
3.	Mar. 24.	Do.	271	119	152	—	33	78 : 100	Those in open full out; those in cover less so.
4.	Mar. 28.	Gt. Hales W. (both C. & G.), S. Walden	214	97	117	—	20	83 : 100	About in perfection.
5.	Mar. 29.	Pounce & another W. (both C.), S. Walden	148	62	86	—	24	72 : 100	About in perfection.
6.	Mar. 30.	Pounce Wood (C.), Saffron Walden	155	79	76	3	—	104 : 100	About in perfection.
7.	Apr. 2.	Same as No. 4	91	41	50	—	9	82 : 100	About in perfection.
8.	Apr. 3.	Peverill's W. (C. & fully G.), Wimbish	148	63	85	—	22	74 : 100	About in perfection.
9.	Apr. 10.	Galley W. (fully G.), Lindsell	148	50	98	—	48	51 : 100	Majority for l. very large. No stimulation.
10.	Apr. 10.	Dow W. (very grassy & partly G.), Lindsell	69	30	39	—	9	77 : 100	
11.	Apr. 10.	Lubberhedges W. (G.), Gt. Bardfield	133	54	79	—	25	68 : 100	
12.	Apr. 11.	Avessy W. (C. & G.), Thaxted	221	98	123	—	25	80 : 100	
13.	Apr. 11.	Bolerow, Grassy & Brockley W. (nearly all C.), Thaxted	239	114	125	—	11	91 : 100	
14.	Apr. 14.	Same as No. 6	99	31	68	—	37	46 : 100	Very large majority for l. Strong stimulation. Perhaps I gathered finest flowers.
15.	Apr. 16.	Peverill's W. (G.), Wimbish	287	112	174	—	62	64 : 100	All sorts gathered. Majority for l. seems to be increasing. 1 equal-styled. 3 of very biggest were all l.
16.	Apr. 16.	Do. (just C.), Wimbish	33	9	24	—	15	37 : 100	Very finest flowers, all growing in open. Of 11 abnormally large umbels, 8 were long, and 3 short.
17.	Apr. 19.	Wood (C.) at Debden	144	58	84	—	26	69 : 100	2 equal-styled.
18.	Apr. 20.	Dawkin's W. (just C.), nr. Thremhall Pry.	209	67	142	—	75	47 : 100	Flowers small and going off.
19.	Apr. 20.	Wood (C.), Broxted	146	56	90	—	34	62 : 100	
20.	Apr. 23.	Same as No. 6	198	79	119	—	40	66 : 100	Fast going off.
21.	Apr. 23. 1883.	Same as No. 6	76	24	52	—	28	46 : 100	Only finest flowers gathered in open; s. had 2 abnormally large, and the l. 4.
22.	Apr. 6.	Same as No. 6	152	72	76	—	4	95 : 100	4 equal-styled, 2 being solitary flowers. Earliest flowers out.
23.	Apr. 7.	Same as No. 16	113	58	53	5	—	109 : 100	2 equal-styled, both solitary flowers. Of the l. 6 were thick-stalked, 3 being flattened; and of the s. 3 were thick, 2 being flattened.
24.	Apr. 7.	Same as No. 15	131	57	71	—	14	80 : 100	3 equal-styled, 1 being a solitary flower.
25.	Apr. 8.	Same as No. 4 (G.)	88	45	43	2	—	105 : 100	
26.	Apr. 13.	Same as No. 16	155	64	88	—	24	73 : 100	Flowers in perfection. 3 equal-styled, all being solitary flowers. Finest flowers gathered. Of the finest 25 were s., 12 being especially large; and 41 were l., 13 being specially big.
27.	Apr. 15.	Same as No. 17	181	88	93	—	5	95 : 100	
28.	Apr. 23.	Monk's Hall Wood (G.)	49	22	27	—	5	81 : 100	
29.	Apr. 23.	Rowney Wood (C.), Wimbish	53	17	36	—	19	47 : 100	Finest selected. 4 finest were all long.
30.	Apr. 23.	Do. (G.)	45	11	34	—	23	32 : 100	Finest selected.
31.	Apr. 23.	Same as No. 15	2040	915	1121	—	206	82 : 100	All sizes gathered. 4 equal-styled. The 4 finest all long-styled.
32.	Apr. 29.	Newpster Wood, Great Saling (C.)	88	30	58	—	28	52 : 100	Finest selected.
33.	Apr. 30.	Meadow near Shalford	26	14	12	2	—	117 : 100	
34.	Apr. 30.	Wood (C.) at Wethersfield	46	14	32	—	18	44 : 100	All sizes gathered. Of the very finest 4 were s., & 6 l.
34.		Totals....	6482	2795	3668	5	29	76 : 100	19 equal-styled.

TABLE III.—THE COWSLIP.

No. of Expt.	Date. 1882.	Locality and Situation.	No. of plants examined.	s.	l.	Majority for s.	Majority for l.	Proportion.	Remarks.
1.	Mar. 29.	Meadow near Saffron Walden	18	7	9	—	2	78 : 100	Flowers only just out. 2 equal-styled.
2.	Mar. 30.	Do.	30	15	15	—	—	100 : 100	Flowers only just open. All I could see.
3.	Apr. 2.	Bank near Saffron Walden	68	30	38	—	8	79 : 100	
4.	Apr. 2.	Same spot as No. 1	54	26	28	—	2	93 : 100	Only just out. Several were apparently equal-styled.
5.	Apr. 7.	Meadow at Strethall	70	40	30	10	—	133 : 100	
6.	Apr. 26.	Meadow at Chignal	139	82	57	25	—	144 : 100	Flowers about in perfection.
7.	Apr. 27.	Do. (different meadows)	189	103	86	17	—	120 : 100	
8.	Apr. 27.	Do. do.	176	97	79	18	—	123 : 100	
9.	Apr. 27.	Do. do.	231	113	116	—	3	97 : 100	2 equal-styled.
10.	Apr. 27.	Do. do.	150	67	83	—	16	81 : 100	
11.	Apr. 28.	Do. do.	306	147	159	—	12	92 : 100	Flowers going off.
12.	Apr. 30.	Same as No. 6	307	140	164	—	24	85 : 100	3 equal-styled.
13.	Apr. 30.	Hedges, ditches, &c., Chignal	136	58	78	—	20	74 : 100	
14.	May 2.	Same as No. 7	293	139	154	—	15	90 : 100	
15.	May 4.	Meadow at Laindon	25	12	13	—	1	92 : 100	
16.	May 5.	Same as No. 13	65	42	23	19	—	183 : 100	Finest only gathered. 2 double umbels.
17.	May 5.	Meadow at Chignal	329	159	170	—	11	94 : 100	
18.	May 14.	Same as No. 6	19	3	16	—	13	19 : 100	Flowers very nearly over.
19.	May 14.	Meadow at Chignal	65	31	34	—	3	91 : 100	Backwarder.
20.	May 14. 1883.	Meadow at Chignal	92	39	53	—	14	74 : 100	
21.	Mar. 29.	Hedgebanks, Chignal	11	5	6	—	1	83 : 100	Earliest flowers out.
22.	Apr. 7.	Same as No. 1	20	7	13	—	6	54 : 100	
23.	Apr. 8.	Same as No. 1	10	7	3	4	—	233 : 100	All that were seen out.
24.	Apr. 13.	Same as No. 1	19	9	9	—	—	100 : 100	1 equal-styled.
25.	Apr. 15.	Meadow at Debden	205	101	104	—	3	97 : 100	
26.	Apr. 21.	Same as No. 1	57	30	27	3	—	111 : 100	
27.	Apr. 21.	Same as No. 1	139	69	70	—	1	99 : 100	
28.	Apr. 24.	Same as No. 1	109	53	56	—	3	95 : 100	
29.	Apr. 24.	Same as No. 1	944	494	449	45	—	110 : 100	Flowers at their best. 1 equal-styled.
29.		Totals....	4276	2125	2142	8	19	99 : 100	9 equal-styled.

TABLE IV.—*P. FARINOSA.*

No. of Expt.	Date, 1882.	Locality and Situation.	No. of plants examined.	s.	l.	Majority for s.	Majority for l.	Proportion.	Remarks.
1.	July 5.	Marsh, near Kampfer	160	73	85	—	12	86 : 100	Flowers nearly gone off. 2 equal-styled.
2.	July 7.	Wet meadows, near Celerina	101	43	58	—	15	74 : 100	
3.	July 10.	Wet spot in pine forest, near Pontresina	136	64	72	—	8	89 : 100	
4.	July 11.	Top of Muot Marmore, near Sils Maria	14	9	5	4	—	180 : 100	Too few to be trustworthy.
5.	July 22.	Side of Alp Nova, St. Moritz	8	2	6	—	4	33 : 100	Too few to be trustworthy.
6.	July 24.	Side of Alp Nova, St. Moritz	8	2	5	—	3	40 : 100	Too few to be trustworthy. 1 equal-styled.
7.	Aug. 5.	Meadow, St. Moritz	156	70	86	—	16	81 : 100	Done flowering.
8.	Aug. 9.	Same as No. 5	177	83	94	—	11	88 : 100	Done flowering.
9.	Aug. 23.	Mountain side, near Roseg Glacier	44	19	25	—	6	76 : 100	
9.		Totals....	804	365	436	1	8	84 : 100	3 equal-styled.

TABLE V.—THE PRIMROSE.

No.	Seeds per capsule, six of each form.	Total.	Average per capsule.	Comparison of highest and lowest Nos. of seeds produced.
1. l. ..	47, 53, 67, 48, 45, 58	318	52	Lowest No., 45; highest No., 67.
2. s. ..	62, 64, 78, 65, 58, 63	390	65	Lowest No., 58; highest No., 78.

TABLE VI.—THE PRIMROSE.

No. of Plant.	No. of capsules set.	*Short-styled Plants.* No. of seeds each capsule.	Total.
1.	2	20, 50	70
2.	3	51, 63, 32	146
3.	7	4, 41, 32, 59, 55, 35, 74	300
4.	24	(72, 68, 62, 45, 60, 73, 45, 67, 60, 87, 64, 60, 71, 14, 59, 73, 19, 18, 37, 70, 72, 33, 65, 55)	1349
5.	10	48, 51, 52, 51, 49, 53, 57, 14, 48, 44	467
6.	5	33, 65, 66, 26, 46	236
7.	13	(45, 16, 61, 89, 12, 55, 66, 51, 79, 87, 23, 27, 59	670
8.	9	68, 56, 41, 59, 53, 61, 12, 51, 61	462
9.	14	(66, 61, 73, 67, 68, 63, 27, 52, 60, 74, 51, 59, 25, 22	768
10.	24	(58, 68, 64, 51, 20, 23, 55, 60, 41, 11, 26, 31, 57, 66, 32, 5, 56, 58, 46, 70, 45, 24, 50, 9	1026
10.	111	Totals....	5494

No. of Plant.	No. of capsules set.	*Long-styled Plants.* No. of seeds each capsule.	Total
1.	4	22, 57, 50, 42	171
2.	1	67	67
3.	2	34 (very minute), 65	99
4.	5	39, 34, 31, 18, 54	176
5.	7	55, 56, 61, 61, 75, 71, 23	402
6.	3	49, 62, 42	153
7.	5	45, 17, 9, 43, 32	146
8.	9	32, 35, 75, 46, 60, 28, 49, 36, 63	424
9.	14	(33, 16, 62, 56, 22, 55, 38, 25, 59, 43, 57, 58, 57, 48 (10th plant could not be found).	629
9.	50	Totals....	2267

TABLE VII.—THE PRIMROSE (AVERAGES).

Description.	s.	l.	Proportion.
Number of plants	10	9	100 : 90
Number of capsules set	111	50	100 : 45
Average number of capsules per plant ..	11	5	100 : 45
Number of seeds produced	5494	2267	100 : 41

Description.	s.	l.	Proportion.
Average number of seeds produced per plant	549	252	100 : 46
Average number of seeds produced per capsule	49	45	100 : 91
Weight of seed in grains	93	36	100 : 39
Average weight of seed per plant	9	4	100 : 44

* The letters "C." and "G." indicate that the wood was either "cut down" or "grown up." Woods in Essex are usually cut about once every fifteen years.

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the relative proportions between the two forms ranging between 32 and 95 as compared with 100. On seven occasions the l. outnumbered the s. by more than 2 to 1, but taking all the observations together we shall see that the average proportion in which the s. stand to the l. is as 76 to 100, showing that in this species the l. are proportionately far more numerous than in the last; and their majority seemed to increase slightly as the season went on. I formerly thought, as in the case of the Primrose, that when plants grew in the open the l. were proportionately more numerous than when growing under cover; but I must admit that the final working out of the results of my observations does not confirm this. I am therefore at a loss to account for the considerable divergence which exists between some of the observations, and I have on this account stated in each case the sort of situation in which the plants grew, that others may draw their own conclusions. It may, however, be mentioned that in six of the seven cases in which the l. were more than twice as numerous as the s. the flowers were all gathered in the open; but against this stand Obs. Nos. 9 and 30, in which the l. were almost exactly or quite twice as numerous as the s., yet the flowers grew in a dense wood. One thing, however, I think, these results do show, and that is that *when under "stimulation"*[19] *the long-styled plants have a great tendency to be the finest.* For instance, of 7 abnormally large umbels selected out of Obs. 14 no less than 6 were long-styled; 3 similar umbels in Obs. 15 were all long-styled; in Obs. 16, when I intentionally gathered 33 of the finest umbels I could see growing in the open, the s. stood to the l. in the proportion of 37 to 100 (the largest majority I ever obtained); and of 11 abnormally large umbels no less than 8 were long-styled. In Obs. 21, when I gathered 76 of the finest umbels I could see growing in the open, the s. stood to the l. in the proportion of 46 to 100; and of 6 abnormally large umbels selected out of these, 4

[19] I shall afterwards explain that by "stimulation" I mean a greatly increased vigour of growth resulting from the access of heat and sunlight to the plants after the cutting down of a wood.

were l. Obs. Nos. 23, 26, 29, 30, 31, 32, and 34 all point more or less clearly in the same direction. In opposition, however, to these examples I wish to refer to Obs. 9, in which (the wood being fully grown up) no stimulation could have come into play, and to Obs. 18, in which the flowers were noted as being small and going off; yet in these cases the s. stood to the l. in the proportions respectively of 47 and 51 to 100. Nevertheless it is certain that, in this species at least, the long-styled plants have, when stimulated, a far greater tendency than the short-styled ones to develop large umbels—often abnormally so,—and this observation may hereafter be found to be of some importance.

Turning now to Table III. we see that, of 4276 Cowslip plants examined on twenty-nine different occasions in various localities in Essex between March 29th, 1882, and April 24th, 1883, 2125 were short-, 2142 long-, and about 10 equal-styled, thus giving the l. a majority of 17. On eight of these occasions, however, the s. had an aggregate majority of 141 out of 1650 plants, the relative proportion between the two forms ranging in these cases between 233 and 110 as compared with 100; whilst on the remaining nineteen occasions (two being exactly equal) the l. had an aggregate majority of 158 out of 2626 plants, the relative proportions of the two forms ranging in these cases between 54 and 99 (omitting Obs. 18 as unreliable) as compared with 100. On one occasion (No. 18) when the flowers were withering, the l. actually outnumbered the s. in the proportion of 100 to 19, but the plants examined were too few in number to afford reliable results. I only give such observations that there may not be the slightest suspicion of my having "cooked" my figures by suppressing anything. On two occasions (Nos. 2 and 24) the two forms were exactly equal in number. Taking, however, the whole of the twenty-nine cases together we shall see that the average proportion in which the s. stand to the l. is as 99·2 compared with 100. The foregoing remarks show that in the Cowslip the relative proportion by which the l. outnumber the s. is not nearly so great nor so regular as in the case of the Oxlip; and is rather less than

with the Primrose, although I am quite unable to account for this difference. Nevertheless the occasions on which the l. outnumbered the s. were more than twice as numerous as those in which the reverse was the case. If we may judge from Obs. 16, in which I gathered 65 of the finest umbels I could see, what was said of the last species, as to the long-styled umbels tending to be the finest, does not appear to apply to this—indeed the exact opposite is the case, no less than 42 of these being short, or in the proportion of 100 s. to 55 l.

Mr. Darwin has stated that the long-styled plants of the Cowslip and *P. sinensis* tend to flower first. From this it would seem probable that such was also the case with the other English species of *Primula*, but I have been unable to observe this; and the only evidence which Mr. Darwin himself brings forward in support of his statement is that he had twelve Cowslip-plants of each form grown under similar conditions, and at one time seven long-styled ones were in flower against one short-styled. My first four Cowslip observations are good tests of this statement, as they were made in places where only a few of the very earliest plants had flowered; yet in the second observation the numbers of the two forms were exactly equal; and in the 1st, 3rd, and 4th the result was just as usual—the l. slightly outnumbering the s. Observations on the Oxlip tend to show that, in this species at least, the opposite of Mr. Darwin's statement is the case; for in my first observation, made as early as March 12th, I managed with great trouble to obtain 231 umbels with flowers only just opened, and in these the s. outnumbered the l.; but three days later in another locality the l. had their usual majority.

Supplementary Remarks on Primula farinosa, &c.

Table IV. shows that, of 804 plants of *P. farinosa* examined on nine different occasions in the Upper Engadine between July 5th and August 23rd, 1882, 365 were short-, 436 long-, and 3 equal-styled, thus giving the l. a clear majority of 71. On a single one only of these occasions did the s. outnumber the l., and then only by 4 out of 14, the numbers being too

small to be reliable. Taking all the observations together we see that the number of l. when compared with the number of s. is as 100 to 84, thus showing a great difference—almost as great, in fact, as was the case with *P. elatior*.

I examined on three occasions, in the beginning of July, 166 plants of *P. latifolia* growing on Pitz Rosatsch and Pitz Corvatsch, of which 86 were short- and 80 long-styled, thus giving, in this species, a majority of 6 to the s. On one occasion only the l. outnumbered the s. (3 out of 19), and on the other two the s. were slightly the more numerous (by 6 out of 112 and by 3 out of 35).

On the 8th of July I gathered two lots of 66 plants together of *P. viscosa* growing on the side of Pitz Rosatsch. In the first lot the s. had a majority of 8 out of 22, and in the second they were in a minority of 4 out of 44. Together, therefore, the s. have only a majority of 4.

With *P. candolleana*, on which I have only made one observation, the case is different. Of 89 gathered on July 11th, on the top of the Muot Marmoré, 30 were s. and 59 l., thus giving the latter a majority of almost exactly 2 to 1.

These, then, are the grounds on which I rest my belief that in Nature the long-styled plants, as a rule, outnumber the short-styled plants by a considerable majority. To arrive at this conclusion I have examined 13,201 plants, and have further shown that in one species at least the very finest plants generally appear among the long-styled ones.

The result of my countings at first rather surprised me, as it seemed most reasonable to suppose that, seeing the two forms require to be reciprocally fertilized, they should live together in equal numbers; and it appeared to me that if one form were to become more numerous than the other the balance would soon be evenly adjusted, because there would not be enough plants of the opposite form fully to fertilize those which were most numerous; and they would thus produce few seeds, whilst the number of plants of this form would in all likelihood completely fertilize the plants belonging to the other form, which would thus produce their fullest complement of seeds. By this means the numbers might be equalized, but it does not seem to be so. I am as yet altogether in the dark as to the *reason* of the greater abundance of the long-styled plants, and it would be interesting to know

whether this peculiarity extends to dimorphic heterostyled species in other genera.

With *Lythrum salicaria* (a trimorphic species) the long-styled plants are not the more numerous, as our member, Mr. Gibbs, will, I understand, show in the future.

Mr. Darwin tells us that with the Cowslip and Primrose the anthers of the two forms do not differ in size, but the pollen-grains of the long-styled form are smaller than those of the short-styled form in the proportion of about 70 to 100. It follows, therefore, although I do not think he mentions the fact, that each long-styled flower must produce about three-tenths more pollen than each short-styled one; and as the l. are about one-fifth more numerous than the s., about one-half more long-styled pollen is produced than short-styled. If, as we shall presently see, the s. produce the most seed by about one-fifth, it is probably that they require that amount more pollen than the l. to fully fertilize their ovules; but, admitting this, there is still a considerable remainder of long-styled pollen which I cannot account for, unless it is that the stigmas of the short-styled plants, being far less exposed than those of the long-styled plants, are less likely to receive sufficient pollen—hence more is produced to avoid there being any lack.

IV.—The Relative Fertility of the Two Forms in Nature.

Mr. Darwin has stated of the Cowslip that[20] "the short-styled plants produce more seed than the long-styled in nearly the proportion of three to two: but if we take the fairest standard of comparison, namely, the product of seed from an equal number of umbels, the excess is nearly as four to three." Of the Primrose he says,[21] "The seeds from the short-styled (plants) weighed exactly twice as much as those from an equal number of long-styled plants." Now, as this seemed to me to be directly opposed to what I have shown under my last heading, and a most extraordinary thing that one form of flower should produce considerably more seed, yet the other form should be considerably more numerous, I

[20] 'Forms of Flowers,' p. 20.

[21] Ibid, p. 36.

thought it desirable to inquire further into the matter. I have therefore taken considerable trouble to corroborate and add to Mr. Darwin's somewhat brief remarks on this subject, with results which will be best seen in the following paragraphs. I have invariably *counted* my seeds, which, as Mr. Darwin admits, is a vastly more correct method than that which he himself, through want of time, adopted, namely, *weighing* them. In most cases I have approximated any remaining decimal to the nearest whole number. My first observation was made on June 13th, 1882, when I procured a number of capsules from wild Primroses, and, selecting six of the finest of each, counted their seeds, though still green. The results, which are given in Table V., show that the s. produced more seed than the l. in the proportion of 100 to 82.

On April 27th I marked 10 long-styled and 10 short-styled Primrose plants growing together in a ditch at Chignal, and gathered the unripe capsules at the end of June. The result of counting their seed is given in Table VI. A considerable number of the flowers had, as usual, produced no seed, but whether these were mostly s. or mostly l. I kept, unfortunately, no account. The average fertility of all the flowers of both forms which produced any seed is compared in Table VII., from which the much greater fertility of the s. may be seen.

It will be observed that the four highest numbers for the s. are 79, 87, 87, and 89 ; and the four highest numbers for the l. are 67, 71, 75, and 75, the highest of the latter being lower by 4 than the lowest of the former ; also that the four lowest numbers for the s. are 4, 5, 9, and 11 ; and the four lowest numbers for the l. are 9, 16, 17, and 18, the four latter numbers in this case being (with one exception) higher than the four former numbers. It is noticeable that each long-styled plant did not produce half so many umbels as the short-styled ones—hence the greater fertility of the latter, as the number of seeds per capsule was almost equal in both forms.

On June 29th, 1882, I obtained from near Saffron Walden the umbels off 27 plants of *Primula elatior* (15 long- and 12 short-styled). Many of the plants had already burst some or

TABLE VIII.—*P. ELATIOR.*

No. of plant.	No. of umbels.	No. of umbel.	Flrs. per umbel.	*Short-styled Plants.* No. of seeds in each capsule.	Seeds per umbel.	Seeds per plant.
1.	2	(1)	7	34, 7, 59, 33, 22, 10, 28	193	
		(2)	6	36, 64, 58, 32, 46, 75	311	
						504
2.	4	(1)	4	36, 3, 35, 15	89	
		(2)	7	45, 21, 30, 23, 36, 50, 55	260	
		(3)	7	43, 24, 28, 48, 4, 5, 44	196	
		(4)	8	41, 52, 4, 26, 8, 25, 10, 9	175	
						720
3.	2	(1)	6	37, 56, 35, 40, 23, 24	215	
		(2)	9	57, 48, 31, 52, 38, 54, 40, 38, 38	396	
						611
4.	2	(1)	6	23, 18, 25, 21, 22, 19	128	
		(2)	8	25, 17, 30, 20, 14, 18, 13, 13	150	
						278
4.	10	—	68	Totals....		2113

No. of plant.	No. of umbels.	No. of umbel.	Flrs. per umbel.	*Long-styled Plants.* No. of seeds in each capsule.	Seeds per umbel.	Seeds per plant.
1.	3	(1)	4	34, 35, 33, 22	124	
		(2)	4	23, 3, 43, 30	99	
		(3)	11	44, 24, 11, 24, 27, 21, 21, 37, 49, 37, 15	310	
						533
2.	6	(1)	3	24, 5, 16	45	
		(2)	3	28, 19, 19	66	
		(3)	8	32, 32, 28, 13, 36, 23, 32, 25	221	
		(4)	10	21, 15, 24, 35, 19, 27, 27, 43, 15, 31	257	
		(5)	10	47, 44, 41, 26, 41, 30, 18, 30, 29, 9	315	
		(6)	10	37, 25, 31, 22, 36, 33, 28, 42, 21, 13	288	
						1192
3.	3	(1)	3	5, 21, 25	51	
		(2)	1	28	28	
		(3)	2	48, 43	91	
						170
4.	2	(1)	10	41, 54, 25, 41, 9, 36, 12, 54, 39, 46	357	
		(2)	9	49, 32, 43, 48, 49, 30, 48, 2, 15	316	
						673
5.	4	(1)	2	27, 28	55	
		(2)	7	19, 6, 9, 24, 57, 14, 2	131	
		(3)	4	48, 1, 2, 27	78	
		(4)	5	31, 20, 12, 1, 7	71	
						335
5.	18	—	106	Totals....		2903

TABLE IX.—*P. ELATIOR* (AVERAGES).

Description.	s.	l.	Proportion.
Number of plants	4	5	100 : 125
Number of umbels	10	18	100 : 180
Average number of umbels per plant ..	2·5	3·6	100 : 144
Number of capsules	68	106	100 : 156
Average number of capsules per plant ..	17	21	100 : 124
Average number of capsules per umbel ..	7	6	100 : 86
Number of seeds produced	2113	2903	100 : 137
Average number of seeds per plant ..	528	581	100 : 110

Description.	s.	l.	Proportion.
Average number of seeds per umbel ..	211	161	100 : 76
Average number of seeds per capsule ..	31	27	100 : 87
Weight of seed (in grains) (27 plants / 15 short (44 umbels) / 12 long (35 umbels)) ..	110	96	100 : 87
Average weight of seeds per plant (in grains)	7	8	100 : 114
Average weight of seeds per umbel (in grains)	2·5	2·77	100 : 111

TABLE X.—THE COWSLIP.

No. of plant.	No. of umbels.	No. of umbel.	Flrs. per umbel.	*Short-styled Plants.* Seeds produced per capsule.	Seeds per umbel.	Seeds per plant.
1.	1	(1)	3	17, 43, 41 (all very small)	101	
						101
2.	2	(1)	6	20, 33, 39, 36, 33, 39	200	
		(2)	5	34, 28, 29, 35, 33	159	
						359
3.	3	(1)	2	12, 17	29	
		(2)	4	47, 48, 50, 16	161	
		(3)	5	8, 52, 54, 51, 32	197	
						387
4.	1	(1)	8	45, 42, 41, 43, 48, 46, 45, 47	357	
						357
5	2	(1)	1	40	40	
		(2)	3	14, 18, 27	59	
						99
6.	2	(1)	1	9	9	
		(2)	11	28, 8, 26, 39, 26, 31, 8, 23, 6, 55, 8	258	
						267
7.	2	(1)	9	24, 49, 13, 33, 38, 51, 28, 27, 39	302	
		(2)	9	19, 43, 33, 44, 42, 39, 38, 43, 48	349	
						651
8.	3	(1)	5	50, 50, 33, 49, 57	239	
		(2)	4	53, 56, 51, 49	209	
		(3)	10	30, 43, 12, 50, 52, 31, 57, 60, 61, 67	463	
						911
8.	16	—	86	Totals....		3132

No. of plant.	No. of umbels.	No. of umbel.	Flrs. per umbel.	*Long-styled Plants.* Seeds produced per capsule.	Seeds per umbel.	Seeds per plant.
1.	1	(1)	1	26	26	
						26
2.	1	(1)	?	0	0	
						0
3.	1	(1)	6	12, 39, 18, 31, 37, 36	173	
						173
4.	1	(1)	4	32, 20, 40, 38	130	
						130
5.	1	(1)	6	22, 37, 28, 38, 21, 22	168	
						168
6.	1	(1)	11	52, 54, 42, 60, 56, 61, 16, 53, 37, 29, 45	505	
						505
7.	3	(1)	5	11, 31, 38, 12, 31	123	
		(2)	3	9, 34, 22	65	
		(3)	5	16, 8, 33, 49, 16	122	
						310
8.	4	(1)	?			
		(2)	?	0		
		(3)	?			
		(4)	7	1, 2, 2, 2, 24, 25, 34	90	
						90
9.	3	(1)	3	23, 35, 36	94	
		(2)	9	21, 15, 32, 20, 21, 26, 28, 16, 38	217	
		(3)	8	7, 18, 13, 11, 23, 18, 21 "Supplementary umbel," 9	120	
						431
10.	2	(1)	4	56, 49, 41, 30	176	
		(2)	12	58, 55, 33, 61, 50, 51, 52, 61, 35, 53, 42, 53	604	
						780
11.	4	(1)	11	41, 24, 59, 62, 65, 61, 69, 7, 43, 36, 58	525	
		(2)	11	44, 23, 54, 22, 42, 34, 41, 29, 59, 3, 4	355	
		(3)	8	7, 27, 49, 6, 59, 28, 54, 10	240	
		(4)	17	27, 46, 43, 31, 20, 26, 19, 56, 38, 59, 26, 26, 53, 44, 57, 36, 24	631	
						1751
11.	22	—	131	Totals....		4364

TABLE XI.—THE COWSLIP (AVERAGES).

Description.	s.	l.	Proportion.
Number of plants	8	11	100 : 137
Number of umbels	16	22	100 : 137
Average number of umbels per plant ..	2	2	100 : 100
Number of capsules	86	131	100 : 152
Average number of capsules per plant ..	11	12	100 : 100
Average number of capsules per umbel ..	5·4	6	100 : 111
Number of seeds produced	3132	4364	100 : 140

Description.	s.	l.	Proportion.
Average number of seeds produced per plant	392	396	100 : 101
Average number of seeds produced per umbel	196	197	100 : 101
Average number of seeds produced per capsule	36	33	100 : 92
Total weight of seed (in grains)	25	35	100 : 140
Average weight of seeds per plant (in grains)	3	3	100 : 100
Average weight of seeds per umbel (in grains)	1·5	1·5	100 : 100
Average weight of seeds per capsule (in grains)	·029	·026	100 : 90

TABLE XII.—*P. FARINOSA.*

No. of plant.	No. of umbels.	No. of flowers.	*Short-styled Plants.* Seeds produced per capsule.	Total.
1.	1	7	53, 67, 52, 64, 69, 60, 0	365
2.	1	7	69, 101, 0, 70, 106, 97, 104	547
3.	1	9	51, 66, 74, 68, 60, 65, 63, 59, 66	572
4.	1	3	39. 0, 38	77
5.	1	4	13, 29, 3, 6	51
6.	1	6	47, 0, 0, 3, 30, 13	93
7.	1	9	92, 42, 26, 31, 45, 64, 70, 65, 80	515
8.	1	15	29, 35, 32, 16, 29, 21, 26, 30, 27, 8, 36, 25, 29, 17, 26	386
9.	1	13	24, 34, 29, 25, 14, 22, 34, 29, 32, 12, 11, 18, 25	309
10.	1	7	3, 49, 24, 45, 68, 67, 73	329
11.	1	4	23, 37, 48, 38	146
12.	1	5	4, 0, 0, 0, 0	4
13.	1	5	14, 0, 0, 21, 33	68
14.	1	3	52, 41, 1	94
15.	1	7	34, 24, 30, 21, 20, 29, 24	182
16.	1	5	28, 31, 44, 36, 25	164
17.	1	5	6 (burst?), 53, 48, 43, 32	182
18.	1	8	37, 0, 41, 39, 27, 13, 15, 16	188
19.	1	8	4, 18, 21, 0, 0, 38, 16, 49	146
19.	19	130	Totals....	4418

No. of plant.	No. of umbels.	No. of flowers.	*Long-styled Plants.* Seeds produced per capsule.	Total.
1.	1	8	38, 53, 38, 90, 0, 0, 0, 18	237
2.	1	4	61, 37, 9, 60	167
3.	1	6	0, 34, 45, 11, 29, 38	157
4.	1	14	42, 16, 67, 53, 58, 19, 56, 6, 62, 66, 50, 65, 13, 49	622
5.	2	3	48, 41, 1	90
		6	38, 3 (burst), 33 (do.), 0, 37, 31	142
6.	1	4	35, 47, 0, 39	121
7.	1	5	37, 47, 64, 0, 53	201
8.	1	3	22, 36, 26	84
9.	1	8	0, 0, 0, 0, 0, 0, 0, 0	0
10.	1	5	63, 75, 64, 70, 32	304
11.	1	5	0, 0, 44, 49, 54	147
12.	1	3	6, 4, 16	26
13.	1	3	0, 40 (very small), 34	74
14.	1	6	32, 32, 41, 47, 30, 0	182
15.	1	6	54, 46, 8, 0, 0, 0	108
16.	1	5	76, 35, 60, 0, 0	171
17.	1	5	4, 34, 15, 30, 48	131
18.	1	12	17, 9, 7, 29, 3, 26, 0, 0, 17, 23, 11, 18	160*
19.	1	10	31, 26, 42, 29, 53, 60, 44, 29, 0, 39	353
20.	1	9	51, 57, 51, 4, 69, 42, 0, 0, 12*	286
21.	1	8	47, 37, 50, 55, 49, 31, 38, 47	354
22.	1	6	0, 6, 5, 11, 11, 5	38
23.	1	5	8, 7, 0, 11, 18	44
23.	24	149	Totals....	4199

* All very small.

TABLE XIII.—*P. FARINOSA* (AVERAGES).

Description.	s.	l.	Proportion.
Number of plants	19	23	83 : 100
Number of umbels	19	24	79 : 100
Average number of umbels per plant ..	1	1	100 : 100
Number of capsules	130	149	87 : 100

Description.	s.	l.	Proportion.
Average number of capsules per umbel (plant)	7	6	100 : 86
Number of seeds produced	4418	4199	100 : 95
Average number of seeds per umbel (plant)	233	183	100 : 79
Average number of seeds per capsule ..	34	28	100 : 82

TABLE XIV.—*P. VISCOSA.*

No. of umbel.	Flowers per umbel.	*Short-styled Plants.* Seeds produced per capsule.	Total.
1.	4	15, 35, 2, 0	52
2.	4	41, 25, 22, 14	102
3.	8	16, 3, 2, 0, 0, 0, 0, 0	21
4.	3	57, 45, 36	138
5.	7	49, 29, 0, 0, 13, 35, 41	167
6.	6	44, 41, 4, 0, 0, 0	89
7.	5	59, 51, 46, 27, 0	183
8.	3	44, 39, 38	121
9.	11	0, 30, 25, 26, 3, 0, 0, 12, 30, 18, 14	158
10.	2	39, 33	72
11.	3	45, 46, 36	127
11.	56	Totals....	1230

No. of umbel.	Flowers per umbel.	*Long-styled Plants.* Seeds produced per capsule.	Total.
1.	6	55, 40, 38, 0, 50, 2	185
2.	6	24, 0, 16, 20, 25, 9	94
3.	5	4, 0, 0, 15, 23	42
4.	5	40, 1, 44, 48, 9	142
5.	3	33, 36, 24	93
6.	3	41, 28, 35	104
7.	3	8, 12, 13	33
8.	5	4, 0, 0, 0, 6	10
9.	3	13, 22, 0	35
10.	6	64, 7, 47, 31, 59, 45	253
11.	4	0, 0, 40, 15 — all on one plant.	55
12.	5	0, 0, 0, 0, 36	36
13.	4	21, 25, 19, 12	77
14.	3	27, 0, 24	51
15.	8	0, 0, 0, 0, 0, 14, 15, 21	50
16.	11	54, 41, 0, 0, 0, 0, 0, 7, 55, 30, 48	235
17.	4	0, 6, 1, 36	43
18.	6	36, 30, 0, 0, 0, 0	66
19.	5	0, 0, 9, 6, 2	17
20.	5	22, 19, 19, 12, 0	72
21.	3	49, 35, 45 — all on one plant.	129
22.	2	62, 0 — all on one plant.	62
23.	4	4, 0, 0, 0 — all on one plant.	4
24.	7	23, 0, 0, 0, 0, 0, 0 — all on one plant.	23
25.	6	22, 0, 0, 0, 0, 0 — all on one plant.	22
26.	9	43, 0, 0, 0, 0, 0, 0, 0, 0 — all on one plant.	43
26.	131	Totals....	1976

TABLE XV.—*P. VISCOSA* (AVERAGES).

Description.	s.	l.	Proportion.
Number of umbels	11	26	43 : 100
Number of capsules	56	131	43 : 100
Average number of capsules per umbel ..	5	5	100 : 100

Description.	s.	l.	Proportion.
Number of seeds produced	1230	1976	62 : 100
Average number of seeds per umbel ..	113	76	149 : 100
Average number of seeds per flower ..	22	15	147 : 100

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all of their capsules, so that I had difficulty in getting unopened capsules, and those I did get seemed to be small, late, and weakly ones. Unfortunately, before I had an opportunity of counting their seeds the capsules of all but four s. and five l. burst, mixing the seed so that I was only able to include them in the total weight of seeds.

It will be seen from Table IX. that these results are not nearly so satisfactory as in the last species. The long-styled plants in this case certainly produced rather more seeds than the short-styled plants; but how to account for this I do not know, as I am convinced from my own experiments and Mr. Darwin's that the s. do, as a rule, produce the most seed, at least in the Primrose and Cowslip, and it is not likely that the opposite holds good with the Oxlip. However, all the capsules were taken from small and rather late plants, which are, I believe, not so likely to be trustworthy; and the small number of seeds actually counted, on account of the bursting of the capsules, is far from satisfactory. I shall recur to this matter at another time. Unfortunately I took no account of the flowers which set no seed, or the result would certainly have been different. The four highest numbers for the s. are 58, 59, 64, and 75; and the four highest numbers for the l. are 49, 54, 54, and 57, the highest of the latter (57) being less by one than the lowest of the former; whilst the four lowest numbers for the s. are 3, 4, 4, and 5; and the four lowest numbers for the l. are 1, 1, 2, and 2, the highest of the latter being less by one than the lowest of the former; so that by this standard of comparison the s. have the advantage.[22]

[22] I must beg leave to differ from Mr. Darwin in one statement which he makes (p. 20), namely, that the fairest standard by which to estimate the relative fertility of the two forms is by the product of an equal number of umbels. Now it is certain that with a species like *P. farinosa*, which rarely produces more than one umbel, this would be the case; but with the other species of *Primula* (which produce an uncertain number of umbels) we can by this standard only estimate the fertility of the *umbels*, not of the *plants* themselves (which is what we want to get at), unless we take account of the number of umbels which each plant produces. The last table is a case in point; the s. umbels are the most fertile in the proportion of 4 to 3, but the l. produce almost half as many more umbels than the s.; so that the l. plants produce on the whole rather the most seeds.

On May 2nd I marked nineteen plants of Cowslip growing on a bank at Chignal, and at the end of June I gathered and counted the seeds. The results are stated in Tables X. and XI., and are certainly rather unsatisfactory; but I give them for what they are worth. Unfortunately, as in the last case, I neglected to record the number of flowers which produced no seed. Had I done so it would have altered the results of this species and the last. With the Cowslip, indeed, I know that most of them were on the side of the l. As with the last, this table shows that the individual capsules of the s. produce, on an average, more seeds than those of the l., but that the l. produce most capsules. However, I do not consider that these two latter experiments are satisfactory, as the plants in the first case were all small and late, and therefore not likely to give reliable results; and in the second they grew in a very unfavourable situation, namely, the bottom of a hedge, where the surrounding grass and bushes no doubt partly choked and smothered them. I could see by the number of *undeveloped ovules that the flowers had not been fully fertilized* in either form; so that I believe the plants had not produced half the seed they should have done, and that which they had produced was, much of it, very small. I shall have a few words to say on this subject later. The four highest numbers for the s. are 57, 60, 61, and 67; and the four highest numbers for the l. are 61, 62, 65, and 69; while the four lowest numbers for the s. are 6, 8, 8, and 8; and the four lowest numbers for the l. are 1, 2, 2, and 2.

Supplementary Remarks on Primula farinosa, &c.

P. farinosa. — On September 4th last, after most of the capsules of this plant had shed their seed, I obtained specimens with unburst capsules from a moist spot on the Alp Nova, just above St. Moritz.

In Table XII. and the following tables I have taken an account of each flower that seemed as if it had ever opened fully —no matter whether it had produced seeds or not. As each plant rarely produces more than one umbel (I do not think that, on an average, more than 1 in 50 does so, and out of the 42 plants above referred to only 1 had two umbels and they small ones) the average number and weight of seeds

produced by each umbel is almost exactly identical with that produced by the plant. It will be seen that the s. are the most fertile in the proportion of 4 to 3. Of the s. flowers 14 bore no seed, but more than double as many of the l., *viz.* 31, were barren. The four highest numbers of seeds produced by the s. are 97, 101, 104, and 106; and the four highest numbers of seeds produced by the l. are 70, 75, 76, and 90. The former were all, however, on one plant, but their lowest number is higher by 7 than the highest of the latter.[23]

P. viscosa.—At the end of August I gathered capsules from plants growing in two places near St. Moritz. Many had already shed their seed and a number of capsules burst, and so were spoiled (particularly of the s.) before I counted them. Table XV. shows that the two forms produce on an average exactly the same number of flowers per umbel, but that each flower of the s. produces 22 and the l. 15 seeds; while the product of each umbel is almost exactly in the same proportion. Of the s. capsules 14 produced no seed against no less than 51 in the l., or nearly 4 to 1. The four highest numbers produced by the s. are 49, 49, 51, and 57; and the four highest numbers produced by the l. are 55, 55, 59, and 64. This is different from usual, as the highest numbers are generally on the side of the s.[24]

P. latifolia.—I have counted a few (605) seeds belonging to this species, but for some reason the flowers had never been fully fertilized—no less than 75 per cent. producing no seed. The s. produced 8 capsules an umbel to 7 in the l.; the s. produced 52 seeds per umbel, the l. 63; the s. produced 7 seeds per capsule, the l. 9, so that in this case, as with the Cowslip, the most fertile flowers were the long-styled. Probably it will be found (as Darwin says is the case with *P. sinensis*) that the corolla in falling off (as it does with this species and the last) drags the anthers over the stigma, thus rendering the l. most fertile; but I shall recur to this subject.

[23] [We learn from Müller's 'Die Befruchtung der Blumen' that *Primula farinosa* occurs both on the Alps and in North Germany, and probably owes this wide distribution to the mild climate succeeding the Glacial period. On the Alps, where it is visited by Lepidoptera in great numbers (Müller noted forty-eight species), the entrance of the flower is narrower than in North Germany, where butterflies and moths are less plentiful, and where the plant has probably to depend for cross-fertilization upon the visits of bees.—Ed.]

[24] The table is, however, seriously wanting in one particular. It does not show the average number of umbels produced by each plant of each form. This is because the plants of this species grow so thickly clustered together on the rocks that I could not distinguish one from the other.

The results of counting 33,409 *Primula* seeds have now been given. These results are not in all cases satisfactory, but the probable reason for this has nearly always been apparent. Admitting, then, the correctness of the statements on this subject made by Mr. Darwin (*ante*, p. 163), it may be well asked, "How can this be reconciled with what was shown in the preceding section of this paper? How, if one form produces considerably more seeds than the other, can that other form be considerably the more abundant in Nature?" I am bound to confess that I do not know. Mr. Gibbs, of Chelmsford, who has had considerable experience in crossing and growing Primulas, and whose opinion is therefore worthy of reliance, has kindly written me as follows:—"If the long-styled form of any *Primula* be most numerous and the short-styled most fertile, it suggests the question—How does this come about? Do the short-styled seeds produce an excess of long-styled plants, or are the seeds of long-styled plants better fitted to survive, though less numerous? It may be that the seeds of the long-styled form have the advantage in precocity of growth or in the distance to which the seeds are thrown, or fall, though only so much as an inch beyond the parental leaves. Many seedling primroses perish from being crowded in germination or from being covered by the leaves of the parent plant." He adds that he "*believes the seeds from short-styled plants give origin to feebler plants.*"

These observations then suggest several interesting inquiries, and lead me to the belief that there is some fact with regard to the reciprocal fertilization of Primulas which, in spite of the attention of Mr. Darwin, has not as yet been recorded. Prof. Oliver has stated[25] that the unfertilized ovules of the s. are considerably smaller than those of the l.; and Darwin supposes that possibly the l. seeds, being fewer, have more room for complete development, although when counting I did not observe any difference in size between the seed of the two forms (the capsules being of equal size, I believe). The fact that, in one species at least, the finest

[25] 'Natural History Review,' July, 1862, p. 237.

plants are generally l. leads one to the belief that they and their seeds have a greater constitutional vigour than the s., which are thus easily eliminated in the "struggle for existence." It seems as if the s. plants produced seed in greater *quantity*, while the l. plants prefer a better *quality*. If only Mr. Darwin were yet alive we might have had one of his keen speculations on this interesting subject. Speculation alone, however, could never decide the question. Nothing but observation and experiment can do so.[25*]

I have promised to recur to those Primulas in which the l. plants produced the most seed. Mr. Darwin showed[26] that with nearly all Primulas the l. flowers are considerably the most fertile when illegitimately fertilized; when he protected the flowers of primroses from insects the l. were considerably the most fertile, though this did not apply to the Cowslip. It seems then as if the l. plants when *under difficulties* have an advantage over the s. plants by reason of the better *quality* of their seed-producing powers. Hence, perhaps, it may be that in some of the plants whose seed I counted, and which it is certain had never been properly fertilized, the l. produced most seed, contrary to what would have been the case under favourable circumstances.

V.—Distribution of the Various Species of Primula in Essex.

Primrose.—The following localities are given in the 'Flora of Essex'[27]:—

"(1) Chesterford, Quendon, &c., but not common around Walden; Dunmow, plentiful; (2) Halstead, abundant; Panfield; (3) between Dunmow and Chelmsford; (4) Stratford, Woodford, common; Epping; (5) Warley and Brentwood, frequent; (6) Rochford and Maldon District, Southend; (7) Kelvedon; (8) Dedham, Harwich. *β. caulescens*, Curt. Lond., 4, 9; (1) Quendon Wood; (2) Roxwell. This is often mistaken for *P. elatior*."

25* [See footnote on this subject in § VII. under *P. elatior*.—Ed.]

26 'Forms of Flowers,' p. 48.

27 'The Flora of Essex.' By G. S. Gibson, F.L.S.; London, 1862, p. 247.

To this I have but little to add, except that the Primrose certainly grows in a great many localities other than those specially mentioned. I have met with it in most parts of the county, except at Walden and Bardfield, and the district lying between those places. I have never seen it more abundant than on the railway-bank and in hedgerows between Sudbury and Chappell, and in the district to the N.W. of Chelmsford, round Chignal, Mashbury, and the Easters, as far as Pleshey. North of that place and about Dunmow it grows more sparingly, but is still not rare—in fact it seems to be a common plant throughout the county, except in the district to the S. and S.E. of Walden, extending, perhaps, as far as Great Bardfield, in which parish it does not grow, as I know from several sources. Henry Doubleday says so;[28] I have never met with it there, and various friends and relatives residing in the parish have informed me that it does not exist there. However, I know that it grows in the parishes of Great and Little Saling, Stebbing, Shalford, and Lindsell, which adjoin Great Bardfield on the S., E., and S.E. It will be observed that the tract of land from which the Primrose is absent is that district in which, of all others, *P. elatior* abounds, and this is both a strange and interesting fact. The valley of the brook Slade, and the Cam seem to mark the western boundary of the Oxlip in the Walden district. On the western side of this the Primrose grows pretty commonly, and is well distributed; thus I have met with it at Clavering, Langley Lawn Wood, Great and Little Chishall, Heydon, Chrishall, Elmdon, Wenden Lofts, near Elmdon Lea and Littlebury Green, Strethall, Great and Little Chesterford, and in the Slade Valley. In the valley of this small brook, which, as I have before stated, forms the western boundary of the *P. elatior* area, a curious mixture of Primulas is to be met with. If we go up it for about a mile from Saffron Walden we shall see two woods opposite one another on either slope. Entering that on the right hand, (Grim's Ditch Wood), we shall find, just on the edge, plenty of Primroses, a few Cowslips, with some Hybrid Oxlips, and an

[28] 'Phytologist,' vol. i., p. 204.

abundance of hybrids between *P. elatior* and *P. vulgaris*. Further in, and for some miles on in the same easterly direction, plenty of True Oxlips, but no Primroses, will be seen. If we next enter the wood on the left hand, or western side (Westley Wood), plenty of Primroses will be found, with a few plants of True Oxlip just on the nearest edge. In Burnt End Wood, and all the other woods to the westward, abundance of Primroses may be found, but no True Oxlips. A reference to the map on page 174 will, I hope, make this explanation clearer. I do not know of any geological peculiarity which could account for this rigid line of demarcation. At Hyde Wood, Little Yeldham, just on the extreme N.E. edge of the Oxlip district, a very similar mixture occurs. *P. elatior* abounds in all the woods for many miles to the westward, and is, I believe, unmixed with the Primrose; but in this wood the Primrose abounds, and it inhabits the whole district to the E. and S.E.; also the 12-acre Wood and an adjoining one, both in Belchamp Otten parish. Oxlips also occur sparingly in these two woods, and more abundantly in the Hyde Wood, where, in a cut down part this spring, I found the two species connected by a great number of intermediate hybrids.

Cowslip.—The following localities are given in the 'Flora of Essex':—

"(1) Walden, abundant; (2) Halstead, common; (3) near Ongar, Springfield; (4) Walthamstow, Woodford, common; Epping; (5) Meadows Shenfield; (6) South Essex; (7) Kelvedon; (8) not found near Dedham, but in some parts of the district (W. H. Coleman)."

This species seems to prefer a chalky soil, and, as might be expected, is very abundant in N. and N.W. Essex, where either chalk itself (as round Walden) or the Chalky Boulder Clay comes to the surface. These conditions only extend as far south as Chelmsford, and it is noticeable that the Cowslip is almost absent from a very large area, composed of London Clay, lying between that place and the Thames. I have nowhere met with it in this district, except sparingly and stunted in a meadow near the old church of Laindon Hills, where it

was considered a rarity. I cannot account for its absence from the Dedham district, unless there be no chalk there. It is very noticeable that the Cowslip grows abundantly throughout the whole district occupied by the Oxlip. It would be interesting if further observations on this species and the last could be obtained, so that a plan might be drawn up showing their exact distribution in the county.

The Oxlip (*P. elatior*, Jacq.)[29]—The statements regarding the distribution in England of *P. elatior* which are usually found in botanical books are, I maintain, calculated to mislead, inasmuch as they do not show the fact that this plant is confined to *one* district, in which, however, it grows in immense abundance, *to the almost entire exclusion of the Primrose, which abounds in the immediately surrounding neigh-*

[29] The account of the first discovery of *P. elatior* in Britain may be found in the early volumes of the 'Phytologist.' To our distinguished Essex naturalist, Henry Doubleday, belongs the honour of having first recognised it in this country, he having found it in the meadows beside the river at Great Bardfield, at which place, as I have reason to know, he frequently visited his first-cousin, the late Richard Smith. He recorded this fact in the 'Phytologist' (vol. i., p. 204) on the 20th of April, 1842. Nevertheless it is certain that it had been previously observed in this country, although not *recognised;* for in the same volume of the 'Phytologist' (p. 191) is a notice of a paper read on February 10th in the same year before the Botanical Society of Edinburgh by the Rev. J. E. Leefe, formerly tutor at Audley End, in which he discusses the Oxlips found in the woods near that place, and which he says do not agree with the figure in the 'English Botany.' This, however, is a mistake, for it is a curious and interesting fact that in the first edition of that work, published as early as 1794, appears a figure which plainly and unmistakably represents the *true* species of Jacquin—not without some faults certainly, as the stalk is too thick, the leaves too pointed, and the arrangement of the flowers in the umbel not quite correct, probably because of its having been drawn from a dried specimen. The figure is, however, fairly true to Nature, and appears in the succeeding editions of the work. The author says—"This specimen we received from the Rev. Mr. Hemsted," and it would be interesting to know where this gentleman resided. Dr. Broomfield (Phytol., vol. iii., p. 693) believed he lived in Essex. It is certain also that Ray must have known the plant, residing as he did for years at Black Notley, just on the borders of the *elatior* district, through the very heart of which he must have passed on his journeys to and from Cambridge.

bourhood. I do not mean to say that it is exclusively confined to Bardfield, for this is not the case. The only claim which the species has to be called the "Bardfield Oxlip" is that the first specimens recognized in this country came from that place. The plant grows profusely in all the woods between Bardfield and Saffron Walden,—a distance of nearly fifteen miles,—while it extends for many miles north, and some miles south, of this district. The statements to which I object are such as the following, in which it is spoken of as inhabiting "Clayey woods and meadows in the eastern counties"[30]; and "In woods and meadows on clay soil. Local. Plentiful in some parts of Essex, Suffolk, and Cambridge."[31] These statements, though they may not be incorrect, still convey a wrong impression. Mr. Doubleday does not make the case much clearer when he observes,[32] "It is not a little strange that this plant should be confined, as it apparently is, to a few localities in Essex." Neither does Mr. H. C. Watson bring out the facts of the case, though he makes, as usual, some most sensible remarks upon the species. He says of its distribution—"Area 3 & 4. S. limit in Essex, N. limit in Suffolk; estimate of provinces 2, of counties 3. . . . . The true species has been observed in different localities in Essex, &c."[33] In the 'Flora of Essex' we find the following list of localities:—

"(1) Very abundant in most of the woods round Walden; Quendon Wood, with *P. vulgaris* and its var. *caulescens* (Gibson); Henham (E. Forster); Bardfield, in meadows, accompanied by *P. veris* and not *vulgaris* (T. Bentall); Saling (E. G. Varenne); Bumpstead, Widdington, Ashdon (Gibson); (2) Sparingly in a meadow near Grinstead Green (T. Bentall); Panfield (E. Harding, of Great Henny); (3) Springfield (A. Wallis, late of Brighton, extracted from Proceedings of Lond. Bot. Soc.); frequent near Broomfield (Jonathan Grubb). This rare British plant is common in some parts of Essex. Near Walden it is much more abundant than *P. vulgaris*, whose place it takes in the woods. . . . . ."

[30] Bab. Man. Brit. Bot., 1867, 6 ed., p. 277.
[31] 'English Botany,' 1867.
[32] 'Phytologist,' vol. i., p. 295.
[33] 'Cybele Britannica,' 1849, p. 292.

I should prefer the insertion of "N.W." in the place of the words "some parts of" Essex, and the statement that *P. elatior* grows at Springfield and Broomfield may be dismissed at once; *P. elatior* does *not* exist in these localities, and the author of the 'Flora' was misinformed by his correspondents. I have marked out on the map the district in Essex in which *P. elatior* grows. It *occupies* this area, growing, generally in great abundance, in *all* the woods in some parts, and in most of the woods and in a few meadows

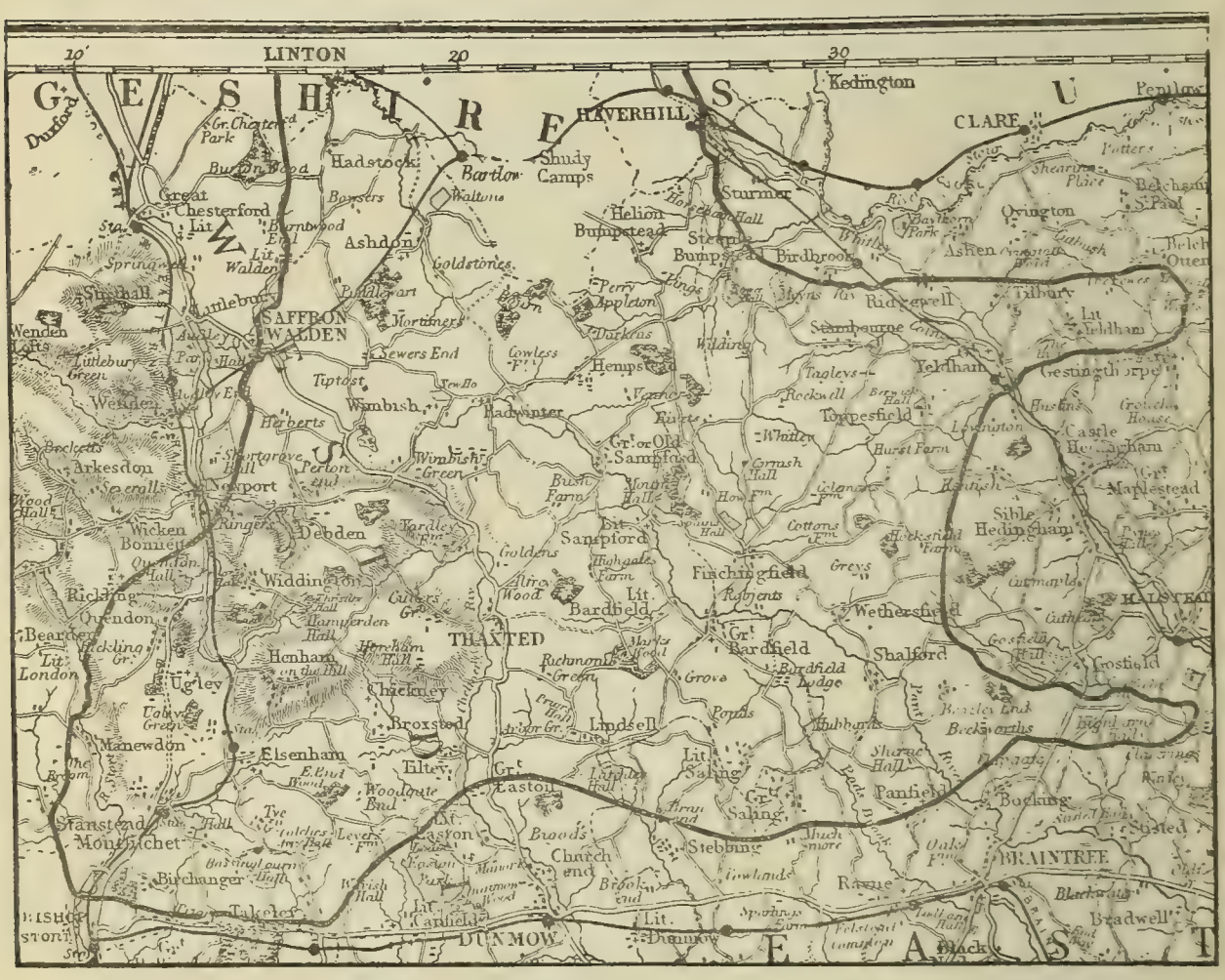


Fig. 2.—Map of part of N.W. Essex, showing district occupied by *Primula elatior*.[34]

in all parts. In gathering information on the distribution of this species I have met with much difficulty, as nearly everyone confuses it with the Hybrid Oxlip. I have, however, been able to verify most of the localities mentioned in the 'Flora,' and to add many others. There are of course many small woods that are not specially mentioned in the following list,

[34] [The Club is indebted to Mr. Christy for this and the two following illustrations.—Ed.]

which will, however, be found correctly to describe the area occupied by this plant in Essex. The boundary-line is a very sharp one, and the Primrose comes close up to it on all its Essex sides. I have myself made out this line, so that I do not think the district can be further extended in Essex unless it be to the N. of Birdbrook, Ashen, and Little Yeldham; although very probably it might be found to extend into the contiguous portions of Herts, Cambridgeshire, and Suffolk.

P. elatior is met with in Great Hales Wood, Little Hales Wood, Monk's Hall Wood, and all the many woods about Ashdon and Hadstock; in Pounce Wood, and all the numerous woods lying round it to the N.E. of Saffron Walden; in a damp meadow and in all the woods round Debden Park; in some woods near Newport; at Widdington, Henham, and Ugley; in Quendon Wood, and the woods round Elsenham, Stanstead Montfitchet, and Birchanger; in Parker's Wood, and Dawkin's Wood, near Takeley; in a large wood and a meadow near Thremhall Priory;[35] in a large wood near Broxted; in the Maze and other woods at Tiltey; in a meadow beside the brook near Lashley Hall, and in Galley Wood, Dow Wood, Bigods Wood, and Dow Wood Springs at Lindsell; sparingly in Fox's Wood, and abundantly in Lubberhedges Wood, Great Bardfield; in a moist meadow near "Woolpits," and in Newpster Wood and several other woods in Great and Little Saling; at Panfield, Grinstead Green, Shalford Park Wood; on the sides of the small ditches in the lowest parts of the wet meadows on both sides of the river near Codham Mill; in a large wood close to Wethersfield; sparingly in a low meadow between that place and Finchingfield; in the Mount Hall Woods, Little Sampford, and in a wet meadow adjoining them; in Hempstead Wood, and Laker's Grove; in Old Park Wood, Stambourne, and a wet meadow below the church; in Pitiful Wood, and a low meadow near Ridgwell, also in a meadow near the church; in Hyde Wood, Little Yeldham; sparingly in 12-acre Wood, Belchamp Otten, also in Avesey Wood, Thaxted; in Bolcrow Wood, Grassy Wood, Brockley Wood, Peverill's Wood, Rowney Wood, Oak Wood, and apparently without exception in all the other woods extending the whole way between Thaxted and Saffron Walden.[36]

[35] 'Phytologist,' vol. i., p. 974.

[36] From this it may be seen that, although the Oxlip does not occupy the whole of any one of Prof. Boulger's Essex Drainage Districts (Trans. Essex Field Club, ii., p. 79), still it inhabits a considerable portion of all of them except No. III. (River Crouch).

Mr. E. G. Varenne, of Kelvedon, who has been most kind in giving me information, writes—"*Primula elatior*, Jacq., has not been found about Kelvedon, Halstead, Braintree, or Coggeshall that I know of. Certainly Mr. Bentall found the plant sparingly in a meadow near Grinstead Green. I have the plant from Wethersfield in 1877, and collected it in meadows above Codham Mill, Wethersfield, in 1879. I may say that Bentall's Grinstead Green locality is the one he meant to indicate when he recorded the plant as growing at Halstead. I believe I have somewhere a specimen, gathered at Grinstead Green and given me by Mr. Bentall, who had a paper-mill there; and on the farm was a brook, a tributary of the Colne, the low meadow-land about it resembling in its character that of the meadows at Bardfield and Wethersfield." Mr. Varenne is explicit on this point because Bentall, writing in the 'Phytologist' (vol. ii., p. 515) on April 16th, 1846, records the plant as "in small quantities in a damp meadow at Halstead." Grinstead Green is two miles from Halstead. From the 'Flora of Essex' (Appendix III.) it appears that *P. elatior* grows in Cambridgeshire, Hertfordshire, and Suffolk, but not in Kent. The Rev. W. W. Newbould has kindly informed me, on the authority of the Rev. — Hillhouse, that it also grows at Clapham and Marston, in Bedfordshire.

I have, unfortunately, never in England seen *P. elatior* growing outside Essex, although it certainly does so. I will take the five counties abutting on Essex in order commencing with Suffolk. The authors of the 'Flora of Suffolk' state (page 53), under the heading *P. veris*, that the Oxlip (*P. elatior*) is "plentiful in moist pastures and hedge-banks at Hawstead, Hitcham, Finborough, &c." I presume the authors were fully competent to identify the species, but "pastures and hedge-banks" are not the situations in which we usually find it in Essex. A specimen in the British Museum (Natural History), South Kensington, is labelled "Hitcham, Suffolk, 1844, C. C. Babington."

In Babington's 'Flora of Cambridgeshire' (1860, p. 188) appears the following:—"Oxlip (*P. elatior*, Jacq.). *P. veris elatior pallido flore.* Ray's Catalogues (1660) 126, and Mar-

tyn's 'Methodus' (1727), 71. Woods, on clay. (1) Wood Ditton, Park Wood, wood near Bartlow, Yenhall Wood, West Wratting, Balsham, Borley, and Westley Woods; (3) Eversden, Kingston, and Hardwicke Woods; Hayley Wood; between Longstow and Bourne; (4) Knapwell Wood, Madgingley Wood (Ray)."

The information given in Webb & Colman's 'Flora of Hertfordshire' (1849, p. 234) is very unsatisfactory. It is as follows:—"What the plant of our correspondents may be we know not, not having received specimens; but we fear our own is nothing but an umbellated variety of *P. vulgaris*. Woods, rare. (1) Woods S. of Brickendonbury; copse, Bramfield Brook Bottom, Stanstead Thrift Wood; (6) Box Wood, Hertford Heath, Glebe Wood, Essendon; (9) wood near Little Heath, Haresfoot Woods; (10) St. Albans, Laverstock Green; (11) Hitchin." Appendix III., 1859, gives also "Coles, and between West Mill and Stonebury."

P. elatior does not occur in Middlesex or in Kent.

All the localities in Suffolk and Cambridgeshire appear to adjoin our Essex stations. Until more satisfactory information is obtained, I prefer to discredit all the Hertfordshire localities, except perhaps Stanstead, which adjoins an Essex locality. Therefore, as the Essex localities all adjoin one another, I believe I am correct in saying that, so far as we know at present, *P. elatior* is confined to a single district in East Anglia, without any outlying stations.

Both Mr. Baker and Mr. Newbould have most kindly assisted me with information as to the geographical distribution of *P. elatior* outside England. It appears to grow in Denmark, S. Sweden, Belgium, Holland, Germany, Switzerland, Central Russia, Caucasus, Siberia (to Altai and River Yenesei), Austria, Hungary, Transylvania, Croatia, Bosnia, Herzegovina, Servia, Dalmatia, Crimea, N. Italy, France, and N. Spain. Mr. Baker writes—"The Oxlip and the Primrose, broadly speaking, seem to have almost the same wide range of distribution in Europe and Asia, and the altitudinal range of both is very wide. Why do they, then, and especially the Oxlip, behave in such an eccentric manner

in Britain? Plants with such a general distribution are mostly found all over England and Scotland. I suspect its occurrence in Iceland is doubtful. I do not think you have got to the bottom of the matter yet by any means." Further information will be found in Nyman's 'Conspectus Floræ Europæa' (iii., p. 603, 1881), and in Lecoq's 'Géographie Botanique de l'Europe' (viii., pp. 141–143, 1858). The latter work gives a table of its distribution. The plant ascends in Auvergne to 1200 metres, in the Caucasus to between 2000 and 3000 metres, and I have seen it at Sils Maria and Stalden, in the Engadine, up to nearly 7000 feet, or, as Lecoq says, "au dela de la limite des sapins." Lecoq seems to have considered it capricious in its distribution, for he says—"Elle habite la France, quoiquelle manque au plusieurs points et notamment à Rocroy et à Vervins."

VI.—Primula elatior and its Variations in Essex.

The confusion as to the nomenclature of the various species of *Primula* which exists in the works of some botanists appears also to obtain in the minds of the inhabitants of that part of Essex in which the above-mentioned species grows. Thus, I have more than once heard the name "Paigle" applied to *P. elatior* by persons who would also have applied the same word to the Cowslip (*P. veris*), as is always done in other parts of Essex, while within a mile or two other persons have assured me that the name "Paigle" was, properly speaking, applied *only* to the Cowslip (*P. veris*)—the name "Cowslip" being always reserved for the true *P. elatior;* and Mr. Varenne, of Kelvedon, has been kind enough to inform me that the name "Cowslip" is, by some persons in that neighbourhood, even applied to the Hybrid Oxlip, the name "Paigle" being always used when *P. veris* (commonly called the Cowslip) is intended. I have not heard the name "Oxlip" applied to *P. elatior*, Jacq., by the country-people inhabiting the district where it grows, but I have, I think, near Chelmsford heard it used for the Hybrid Oxlip. Of the latter and the True Oxlip Ed. Forster remarks (Phytol., i., p. 974)—"I suppose both are called Oxlips in some counties; in Essex I know they

are indiscriminately Cowslips, the *P. veris* being invariably 'Pagil.'"

It is not a little strange that nearly all continental books of Botany written in French describe the True Oxlip as "*inodore*," and this same statement that it is *scentless* has crept into many English works. It must, however, be incorrect, since Mons. Caviezel, of Pontresina, has assured me that the species which grows in the Engadine *is* scented; and I am satisfied, from what I have seen of it there, that this species is identical with ours, which is strongly scented.[37] It is still more strange that in England the True Oxlip grows in different situations from those which it inhabits on the Continent. There it generally grows in the *open*, in mountainous districts, flourishing in the meadows, on roadside banks, moist alpine pastures, river-banks, and similar places; while here it grows almost exclusively in *woods;* but, as Prof. Boulger has remarked to me, the habitats of some continental animals and plants are often different in character from those of the same species with us. The quantity which grows in the open in Essex hardly bears any comparison with that growing under cover, but, wherever the plant grows, it always likes a very damp situation, often almost flourishing in a bog. The Essex localities in which *P. elatior* grows in the open are almost all situated at the S.E. end of the area above described; and these localities, so far as I am aware, agree very closely in their nature, being all (with one exception) low, moist and often swampy meadows composed of blackish, alluvial soil lying in a narrow strip along the banks of various streams and rivers. I have seen it growing in such situations pretty abundantly at Lindsell, sparingly at Little Saling, and abundantly on both sides of the River Pant, at Bardfield, for about half a mile between the bridge and Beslyn's; it also grows in similar situations beside brooks at Stambourne, Ridgwell, and Wethersfield; and Ed. Forster (Phytol., i., p. 974) records having met with it plentifully in "a wet,

[37] Prof. Boulger remarks that this may possibly be true of some continental localities. He has been informed that *Gymnadenia conopsea* is scentless at Box Hill, Surrey.

hilly pasture on the left of the road from Bishops Stortford to Takeley, between the two-mile stone and Thremhall Priory." Doubtless other localities of a similar nature might be discovered. I have, however, only met with one locality near Saffron Walden (that is, at the N.W. end of the *elatior* district), or indeed within ten miles of that place, where the plant may be described as growing naturally in the open. On April 19th, 1882, I saw it sparingly in a small sloping swampy pasture between two small woods, in which it grew plentifully, just on the edge of Debden Park. The one locality which differs in nature from all the rest I met with on the 3rd of the same month, when I saw it growing sparingly in a dry pasture close to "The Roos," near Walden, but I learnt on enquiry that this spot had been a wood within comparatively a few years. There this species grew intermixed with a profusion of Cowslips, but, though I searched diligently, I could see no trace of any intermediate forms. I have also searched for hybrids in the localities mentioned above, where the Cowslip occupies the higher and drier parts of the meadows, and generally mingles a little with the Oxlip on the edge of the lower and moister part, but I have never seen the least trace of hybrids between the two in such spots. I have never seen any varieties or monstrosities of *P. elatior* when growing in the open. In this case the plants are generally small, each producing one, or perhaps two short flower-stalks, only about four inches high, bearing small umbels of only four or five flowers each.

As I have already said (and as will be seen from the list of localities previously given) *woods* are, in this country, the usual habitat of *P. elatior*. It makes, however, all the difference in the world to the plants whether the wood be thickly grown up or freshly cut down. In the former case the plants, though generally of good size, comparatively seldom produce flowers, and then only in small umbels. A person walking through such a wood in spring would certainly not think the Oxlip an unusually abundant plant. It is, however, the fate of most woods to be cut down every fifteen years or so. This is accomplished in the winter, and

the following spring witnesses a vast change in the abundance and luxuriance of the Oxlips. The sudden access of the sun's light and heat acts as a *stimulus* which induces every plant to grow and flower to its utmost. The size of the plants at once increases, the number of umbels is largely augmented, the flowers come out finer and often twelve or fifteen on an umbel, and from a little distance the ground often appears to be of a fine yellow colour. Monstrosities and abnormally-developed flowers, leaves, and umbels are also at once produced. The change wrought by the cutting down of the wood is, however, not generally seen at its best until the following spring, when the plants, having had time to grow, increase still more in size and luxuriance, and produce larger umbels, with finer and more numerous flowers. The profusion when in this state must be witnessed before it can be fully realised. I have never seen anything like the same effect produced by Cowslips or Primroses.[38] The stimulus generally lasts, I think, until the third year (or occasionally, perhaps, until the fourth), but all depends upon the rapidity with which the grasses and other herbage spring up and smother the Oxlips. As the wood grows up these last generally revert to their original condition, and the huge

[38] On the 15th of April, 1883, I was in Peverill's Wood with my cousin, Mr. Reginald W. Christy, when he was so struck with the extraordinary profusion of the Oxlips that he suggested a calculation. We accordingly selected an area four yards square, which seemed to be a fairly typical one. Certainly there were many other spots of equal size containing more plants. On this patch we counted carefully all the plants, and found that there were 231, or an average of about 14·43 to a square yard. These bore altogether 723 umbels of all sorts, or an average of about 3·13 to a plant. Certainly this last is a very low average, as we counted no less than 56 umbels on one plant which was not larger than hundreds of others that could have been found around. We next found out that the stimulated part on which the plants grew so thickly measured 88 yards by 440, so had an area of about 38,720 square yards. Part of this had been cut the previous winter, and part the one before that. Taking these figures we found that on this area there must have been about 558,730 plants, with 1,748,824 umbels. From these figures, with the aid of others in Table IX,. an interesting calculation might be made as to the number of seeds these plants should produce annually.

umbels and other monstrosities gradually disappear.[39] From an observation which I made in Peverill's Wood on the 3rd of April, 1882, I conclude that this effect, which for convenience sake I have designated "*stimulation*," is very exhausting to the plants. The old flower-stalk becomes hard and dry, and remains standing until the following year; and I noticed that those plants which had the most and the largest of these old stalks were then very small and stunted, often bearing only a few leaves with no flowers, from which I conclude that the cutting down of the wood at the beginning of the previous year had *over-stimulated* the plants to flower; and the consequence was that they were too exhausted to make any display this spring. There were, however, at the same time and place, many plants that were then in flower as profusely as any had been the year before, and I noticed that these had on them very few of the old flower-stalks; I concluded that they were too young to flower the year before, as one-year-old *Primula* plants seldom produce flowers. This stimulation of the Oxlip is very curious and interesting, and I do not know of any plant which is affected in like manner to an equal extent. It seems to indicate that it was formerly a species liking the open, but which has now, for some reason, changed its habits.

Before proceeding to describe the variations and monstrosities produced in the Oxlip by stimulation, I wish to observe that I have never met with anything leading me to the belief that it is not a good and true species, perfectly distinct from both the Cowslip and the Primrose. With the exception of certain solitary flowers borne on single pedicels, the characteristics of the plant may be said to be *almost constant*, the flower varying only a trifle in size and in intensity of colour according

[39] As instances of this I may say that Pounce Wood was cut down in the winter of 1879-80. In the spring of the latter year I noticed scarcely any varieties there, but both in 1881 and 1882 I obtained many, though none in 1883. Great Hales Wood was, I think, cut in the beginning of 1877 or 1878. What grew in 1879 I do not know, but in 1880 I got many monstrous umbels; in 1881 a very few, but in 1882 none, the bushes having then begun to grow up; part of Peverill's Wood, Wimbish, was cut in the winter of 1880-81; in the spring of the latter year some varieties were obtained; in that of 1882, many.

as the plant grows in a favourable or an unfavourable situation. Its variations (with the trifling exceptions just referred to) may nearly all be set down as monstrosities, due, in all probability, to stimulation, as they occur but rarely when the plant grows under cover.

Fig. 3.—Abnormally large umbel of *P. elatior*, with flattened (fasciated) scape or "stalk."

One of the earliest results of stimulation consists in an increase in the size of the plant, which often produces ten or twelve umbels with thick round stalks, a foot high (sometimes more), the umbels consisting of ten, twelve, or fifteen unusually large and healthy-looking flowers. This is what happens to most plants; of course there are smaller ones, but some umbels are produced which are still more abnormal, and in woods recently cut down these are by no means uncommon. Their stalks generally begin to thicken more or less sideways, until they are often a quarter of an inch, or even sometimes half an inch, *broad*, but no thicker than usual. Often, too, they are over a foot long. But

the limit of stalk-development does not end here, as I have on several occasions picked fasciated stalks of much greater width. For instance, on April 29th, 1882, I obtained two in Pounce Wood, each of which was over 1 inch broad, not thicker than usual, about 6 inches long, and uniform in thickness all the way up. On April 25th, 1880, I gathered a similar one in Great Hales Wood which was 11 inches long, and three-quarters of an inch broad, but quite thin. Another on April 16th last was 6 inches long, split and curled right round (down and up again), and had 137 flowers in its umbel. These very broadest ones nearly always appear just at the end of the season; and they have a tendency to twist right round, sometimes splitting down their whole length by so doing.[40] The number of flowers on these fasciated stalks seems to have hardly any limit, but depends a good deal on the extent to which the stalk is flattened. Thus the smaller ones bear 20, 30, or perhaps 40 flowers; the medium ones 50, 60, and even 100 or over, as I have counted comparatively small ones which have yielded 55, 83, and 96, while the very largest bear sometimes, I am sure, quite 200 blossoms. Of course these flowers that are so clustered together are not of large size. In the very largest umbels there are many buds which never open, or only imperfectly. With these flat-stalked ones, too, the shape of the umbel entirely changes. The flowers hang over thickly on all sides or stand upright as best they can, instead of having a regular order—hanging over on one side only.

On a few occasions I have met with these broad-stalked specimens growing under thin cover, but when they occur I regard them as due almost always to stimulation. Occasionally specimens may be met with in which the peduncle suddenly turns aside, and then growing up again for two inches or so, bears the umbel; but, out of the bend, grow several pedicels and often a green leaf. On one occasion only have I met with what I have called, when speaking of the Cowslip, a "double-umbel." Another variety, by no means rare, which occurs

[40] Prof. Boulger has suggested that this twisting and consequent splitting of fasciated stalks may be due to the circumnutation of the umbel.

under stimulation may be called an "irregular umbel," by which I mean that the flowers do not all spring from one centre, but some grow out of the stalk a little below the rest, and, reaching up, mingle with them; or that the umbel is slightly irregular in some other way. This variety sometimes appears in conjunction with another in which one or two leaves (rarely more) spring out of the umbel just below the pedicels. Generally these leaves are about an inch long, though sometimes more, and are situated opposite one another. Presumably they are bracts abnormally developed, as I have seldom, if ever, seen this form except under stimulation. This variety seems to affect particular plants, and two examples may often be found on one root. It is not uncommon in the garden Auricula, but I never observed it in the Cowslip. It often occurs very early in the season; for instance, I obtained an umbel bearing a leaf $2\frac{1}{2}$ inches long on the 15th of March, 1882, before any of the other varieties described had been observed.

Among the other minor varieties I may mention that I have twice come across bifid leaves, both growing in the open in Pounce Wood. The first was divided in two very near the bottom. The second was on a peculiar plant I gathered in March, 1882, which bore both a bifid and a trifid leaf, the branchings taking place just above the ground; also a very short thick peduncle about one inch high, supporting innumerable buds and three or four opened synanthic flowers, having a great number of calyx-teeth, many petals, twelve or thirteen stamens, and a large flattened stigma. I have met with these monstrous flowers several times, but always among normal ones, on fasciated stalks growing under stimulation, and they have always been short-styled, like the flower last mentioned. They are generally furnished with a large number of calyx-teeth, petals, and stamens, so that the opening of the tube becomes a long narrow oval; I have also seen a double-flower with one common calyx, the corollas opening into one another at the side, and the pistil branching about its middle, one branch going into each half. On several other occasions the pistil has been abnormal—generally

branched. On the 30th of March last I gathered a short-styled flower that had four or five short malformed pistils growing up out of the ovary. Occasionally in the long-styled form it seems to catch among the stamens, and is so stopped in its growth. I have also several times seen a single stamen of a flower developing into a small petal, as is often the case in cultivated Primulas.

I wish here to repeat that I have always met with the varieties[40*] above-described growing in those parts of woods recently cut down, and I therefore regard them as due rather to stimulation than to any great tendency to vary, which the Oxlip in particular possesses. With the next very interesting variety of *Primula elatior* (Jacq.), which I shall mention, the case is almost certainly different. It has often been stated, and used as an argument for the specific distinctness of the True Oxlip, that it never produces single flowers on a stalk or pedicel like the Primrose. Mr. H. Doubleday, in first announcing his discovery of it, writes (Phytol. i. 204)—"In no instance have I seen single-flowered stalks as in the Primrose"; and before a meeting of the London Botanical Society (*loc. cit.* 239) Mr. Edward Doubleday said that his brother "had examined thousands of plants at and near Bardfield, and never observed a single instance of a solitary flower being thrown up as in the hybrid." As a fact, I can state that these solitary flowers are not uncommon in this species, although they have hitherto apparently been unobserved. I

[40*] [We have not ventured to alter Mr. Christy's diction with respect to the use of the word "variety," but we think that many of the instances recorded by him would be more correctly classed as "aberrations." We submit that the term "variety" should be restricted to those forms which are more or less permanent in one locality, and the term "race" or "sub-species" to those forms which come true from the seed; while an "aberration" or "sport" is a mere temporary condition induced by circumstances of changing environment or varying amount of nourishment; extreme instances, resulting in the abnormal (teratological) development of one or more organs, being "monstrosities." These three forms inferior to a "species" may thus be arranged in order of increasing stability,—aberration, variety, race,—the variety being the middle term of the series. Most of Mr. Christy's "varieties" seem to belong to the first category.—Ed.]

have made several precise observations on these flowers, and can state:—(*a*) That they are in every respect true Oxlip-flowers, and not hybrids; (*b*) that they only appear at the very commencement of the flowering-season, and are soon over; (*c*) that they are always borne on a separate part of the plant, namely, a short thick off-shoot which joins the root just below the ordinary crown of leaves; this shoot very often bears a normal umbel also, but seldom any leaves; (*d*) they always appear on plants which bear umbels as well; (*e*) these umbels always flower latest; (*f*) I have never observed solitary flowers to produce seed, although they may do so; (*g*) they are subject to much variation and monstrosity. To the foregoing statements I have observed no exceptions. It seems to me that there can be little doubt but that these flowers are borne in what may be termed a sessile umbel; otherwise I can see no reason for their being borne on a separate portion of the root, although the circumstance of their early flowering seems to indicate that they may be a relic of an original acaulescent mode of flowering. Prof. Boulger, who has kindly favoured me with his opinion and has also laid the matter before the Scientific Committee of the Royal Horticultural Society, writes:—"I think your surmise (that these flowers are borne in sessile umbels) is altogether correct. I notice that they are on what, from their slenderness, &c., are obviously elongated pedicels, not peduncles; that they spring from one part of the rhizome, apparently a front portion or late development, and that they are apparently all in the axil of one foliage-leaf, although with each pedicel in the axil of a very narrow leaf, which is to all intents and purposes an involucral bract. They thus seem to me an umbel with long pedicels and suppressed peduncular internode, as if the species were acquiring the character of the Primrose. Query: Is there any advantage in its so doing? Mr. Henslow remarks that, in cultivation, the tendency is towards caulescence."

I first noticed these flowers on March 31, 1880, in Dow Wood, Lindsell, and have seen them every season since; but never so numerous as this spring (1883), because I did not discover

until they were nearly over last year that the time to find them was very early.[41] I have never myself observed similar flowers on the Cowslip (when pure) or on *Primula farinosa;* but Mr. Clark, of York, has informed me that he remembers meeting with single-flowered cowslips many years ago at Street. I am sure, however, that they are extremely rare. I have sometimes, in various species of *Primula*, seen a single flower on a jointed stalk, but in this case I regarded it as belonging to an umbel the rest of which had not been developed; in other words, the peduncle supported a single pedicel only. With these solitary flowers of *P. elatior*, however, the case is different. They were on jointless stalks, generally about 3 inches long, exactly as in the Primrose. I have already stated that these flowers are very liable to become abnormal; and it is strange that they are very often subject to one most marked variation, and rarely to several minor variations, which I have never on any occasion observed the flowers to be subject to when growing in an umbel. I refer to what may be called the *leafy* or *foliated calyx*. This, in the case of these solitary flowers, appears so commonly that I should think nearly half of them show it more or less. Sometimes the edges of the calyx-teeth merely become green and wrinkled, but oftener are developed into complete little leaves half an inch long or more, and extending above the petals; while on several

[41] In 1881 I noticed the first plant bearing them on March 17th, and several more on April 6th,—a late season,—but they seem to have disappeared soon after. In 1882 I noticed the first plant as early as February 12th (flowers not quite open; very early season, however). On March 12th, in Monk's Hall Wood, I noticed at least twenty-five or thirty such plants among a great number of others just on the verge of coming out. On the 15th, however, I was astonished at the number I saw in Pounce Wood. The Oxlips were just on the point of coming into flower abundantly, and, after searching for plants bearing these solitary flowers, I believe that at the very lowest computation I saw fifty of them. On the 24th and 26th nothing like as many of these were noticeable; on the 28th I saw only two, on the 29th one only, and after that, though many thousands of plants passed under my eyes, I only saw one or two. On March 21st, 1883, nearly all the flowers I could find open in one wood were solitary ones, but on the 23rd of the following month at the same spot I could not detect a single example.

occasions I have seen them so much developed that the five leaves have been each 1½ in. long, all the inner floral organs remaining very small and aborted at the bottom of the cup thus formed by the calyx. These solitary flowers often appear on

Fig. 4.—Plant of *P. elatior*, showing peculiarities usually connected with "solitary" flowers, *viz.*—the "root-branch"; solitary flowers with and without foliated calyx, associated with an umbel bearing leaves. An umbel from the main root is shown in bud.

the same plant, both with an ordinary and a foliated calyx. Whether this peculiarity is due to stimulation or not I cannot say, but it is certainly very strange that it never, under any circumstances, appears on flowers when growing in an umbel. Possibly the variety which has leaves in the umbel may answer to it in normal flowers; and this seems the more likely, as I have not unfrequently noticed that the umbels

borne on the same off-shoots as the solitary flowers have developed leaves, or are in some other way irregular. The calyx of the cultivated umbellate Polyanthus is often foliated. In fig. 4 all these variations are shown upon one plant. These solitary flowers are also subject to other minor variations—particularly to malformation. For instance, a few of the earliest short-styled flowers I saw seemed to be devoid of some of their stamens, one had a narrow petal growing up among its stamens, another had several petals (two of which were partly green and inclined towards leaves) growing up with the calyx far below the rest of the petals. Sometimes the tube of the corolla is split down one side, and the petals on one side of the split are placed a quarter of an inch or so higher than those on the other. The style is also very often imperfectly developed, causing a considerable number to be equal-styled, as may be seen from the table in Section III. On two occasions this spring I saw a single flower of what is often called the "Hose-in-Hose" aberration (prolification), which I have never before heard of as growing in a wild state. They were both found in Pounce Wood, were long-styled, and each had a slightly leafy calyx, with the corolla as usual; but out of the middle of it grew another flower-bud, with calyx, corolla, and everything complete, but young, unopened, and thrusting the pistil of the outer flower to one side. This completes my list of the variations which I have observed in *Primula elatior*.

The shape of the normal Oxlip umbel and the arrangement of its flowers is both peculiar and graceful. The base of the umbel is not set horizontally on the top of the peduncle, but slightly inclined, so that the flowers all face one way. The topmost flowers face nearly upwards, and their pedicels have a graceful double curve. This curve varies gradually with the flowers lower down, so that the lowest are almost pendant. Those flowers which are altogether pendant are those coming from the very middle of the umbel; their pedicels make their way out between those of the lower and outer flowers, and hang over in a complete semicircle. The topmost flowers open first, and the opening gradually extends to

the lower ones; so that the former have often done flowering, and their ovaries have already swelled to the size of a No. 1 shot,[42] while the latter are scarcely open. The top flowers, too, are, I believe, the most fertile, often producing seed under difficulties when the rest are barren.

VII.—General Observations upon the Natural History of the Three Essex Species of Primula.

The three species differ materially in the situations which they inhabit, the time of year at which they flower, and the insects by which they are fertilized.

The Primrose prefers to grow in woods,—often thickly grown-up ones,—but is also very commonly seen in ditches, on banks, or sometimes out among the grass of meadows in moist shady places. When the woods in which it grows are cut down, I have never noticed that it is at all unusually stimulated in growth (as is so commonly the case with the Oxlip), unless the form designated the Umbellate Primrose be attributable to this cause. The districts in Essex inhabited by the Primrose are often not those inhabited by the Cowslip, and on the Continent the species seem to occupy altogether different regions.

Many authors state that the flowers even of the pure Primrose are borne in a "sessile umbel," or one without a peduncle or scape; but it seems to me that with pure plants this is seldom obvious; and Mr. Darwin states ('Forms of Flowers,' p. 70) that "no trace of it can be found in the pure Primrose." It is difficult to determine the season in which the Primrose flowers; a mild autumn, and sometimes even a mild winter, will bring them into flower, and cultivated specimens sometimes bloom all the year round. I have many records of Primroses blossoming in December and January, both wild and in gardens. On December 23rd, 1876, and October 2nd, 1882, I saw them out abundantly (the weather being mild) in two woods which had both been cut down the previous winter. After the severe winter of 1879–80, how-

[42] The corolla does *not* fall off, as in some Primulas, but the ovary in growing stretches it at the bottom.

ever, I noticed the first wild ones out on January 29th; on February 7th others, and in plenty on the 15th; while on December 27th, 1880, I found several plants in flower in spite of the cold weather. I believe that the Primroses in a cut-down wood at Chignal flowered during eighteen consecutive months. Those which bloom thus in the autumn and winter are generally small, and with very short stalks. The average time at which the main body of plants flower in Essex may be set down as the middle of February or the beginning of March, while very often a succession of flowers continues to appear until the middle of May. This species has a much longer period of flowering than the other two. It is not much given to variation when pure and uncultivated; indeed, if we set aside all those cases in which the flowers exhibit more or less relation to the Cowslip and are borne in a more or less regular umbel, there is very little to notice under this head, so far as I have observed. The variation in the size of the flower is often great, but is generally occasioned by the plant growing in a favourable or an unfavourable spot. One I gathered at Castle Hedingham measured $1\frac{3}{4}$ in. across the corolla. The number of petals also is given to slight variation. Red flowers sometimes appear on truly wild plants, but not frequently in Essex. I have seen a single plant of this sort from Epping Forest.[43] Flowers with petals almost white also appear, and they are commoner in Essex than red flowers. I have been told that they are quite common in Horsfrith Park Wood. The leafy or foliated calyx sometimes, though rarely, appears in a state of nature. In the spring of 1882 I had three short-styled flowers sent to me that were gathered on February 28th from a plant growing among many normal ones on a bank near Chignal. They all had the five calyx-teeth developed into small green leaves, which were long enough to project beyond the petals. One of them had all the inner floral organs abortive, having remained very small and undeveloped at the bottom of the

[43] Whether there be any truth or not in the very common belief that Primroses planted upside-down in cow-dung turn red I cannot say, but this is widely credited in Essex.

calyx-tube. In 1881 the calyxes of several flowers on a plant that usually produces normal flowers continued to develop into leaves about 1½ in. long, after the corolla had withered some weeks. My friend Mr. P. Sewell, of York, has sent me specimens of flowers having the corolla foliated exactly as the calyx so often is. The plant bearing these was originally found wild in Ireland. I believe this is a rare aberration.

It is not my intention here to speak of the numerous forms which this species assumes under cultivation; but I may describe the strange conduct of one plant that grew in my garden at Chignal, and produced all through the autumn of 1879 flowers which were normal in all respects, except that they were red and had a calyx of five small leaves each about one inch long. By the middle of the following May the blooms were few in number, and changed in nature, the calyx-leaves being then smaller and shorter. The central part of each was still green like a leaf, but down each side was a wing or strip half as broad as the green part, which was smooth and coloured like the petals, so that the flowers were evidently inclining towards the "Hose-in-Hose" variety. The following autumn, if my memory serves me, the flowers bore ordinary leafy calyxes. Polyanthuses with a parti-coloured calyx may sometimes be seen in gardens, but I do not know that they ever change their nature.

As is also the case with the Cowslip and Oxlip, the corolla withers up, but remains on the plant for a long time. The capsules differ in their shape and habit from those of the other species, being much shorter and rounder, and prostrate instead of erect. They lie down upon the ground when mature, and it is possible that this may be the means adopted by the plant for sowing its own seed, as I have sometimes seen the capsules quite covered up by worm-casts. The dead capsules do not, I believe, remain on the plant until the following year, as is the case with most other species of *Primula*.

All gardeners know how persistent sparrows are in pulling off the Primrose-petals for some reason best known to themselves. Sparrows, however, are not the only delinquents, as

I have observed many flowers pulled to pieces when growing under cover of thick woods, where sparrows are not accustomed to go. At first I suspected mice, and set a trap accordingly in a patch of flowers, but with no result; and I now think that blackbirds were the destroyers. A gentleman accustomed to grow Primroses informs me that chaffinches, linnets, and greenfinches are also sinners in this matter. The calyx and corolla are nearly cut through just above the ovary, and are left upon the ground in numbers, generally showing the marks of the two sides of the bird's bill. The ovary itself and the remaining portion of the calyx is then neatly cut off the top of the stalk, and is carried away and probably eaten by the bird, as it would doubtless be nutritious. The havoc thus worked in woods and gardens is often very great, and must seriously diminish the total quantity of seeds produced. Since making the foregoing observation I learned that in 1874 a correspondence on the same subject in 'Nature' (ix., p. 482) was started by Mr. Darwin, who had noticed similar facts. The practice of destroying the flowers seems to be very widespread over the county, and I do not think there can be the slightest doubt but that the object of the birds is to get at and eat the ovary. Mr. T. R. Archer Briggs, of Plymouth, says—"The tubular portion of the Primrose is much infested by small insects (? Thrips), and I have sometimes thought that a bird for the sake of feeding on these might be led to bite the flowers." This is unlikely to be the case, as the tube is seldom opened; and I have even found several live beetles in it after being cut off. I have occasionally seen the Cowslip-flowers nipped off, and frequently those of the Oxlip; these latter seem to be most relished by the birds while they are in the bud, and I have often seen little heaps of them lying around the plants. Some of these remnants of unopened buds had been robbed of their corolla, anthers, style, and ovary. The anthers of Oxlip-flowers very often disappear, and, as I have sometimes seen slime on the flowers, I suspect the agents to be slugs. The same is often the case with the Cowslip, and I have several times caught a small snail (*Helix hispida*) on the flowers.

Darwin shows ('Forms of Flowers,' p. 36) that Primroses are fairly fertile when protected from insects [? large insects], but that the long-styled flowers are, under these circumstances, by far the most productive. He also says (Ibid., p. 36):—"It is surprising how rarely insects can be seen during the day visiting the flowers, but I have occasionally observed small kinds of bees at work; I suppose, therefore, that they are commonly fertilized by nocturnal Lepidoptera"; and after saying that bees commonly visit the Cowslip, he adds (p. 56):—"The Primrose is never visited (and I speak after many years' observation) by the larger humble bees, and only rarely by the smaller kinds; hence its fertilization must depend almost exclusively on moths. There is nothing in the structure of the flowers of the two plants which can determine the visits of such widely different insects. But they emit a different odour, and perhaps their nectar may have a different taste." Now on this point I must again differ somewhat from Mr. Darwin, as I have not unfrequently seen humble-bees visiting Primroses. A specimen of *Anthrophora acervorum* in the middle of March last visited five flowers growing near together in Westley Wood, Saffron Walden; and my friend Mr. H. Richardson, of Newcastle, observed a common large banded humble-bee visit four flowers on three different plants near together in the beginning of May, 1881; he has also seen a bee visit the Hybrid Oxlip. On one occasion, in the beginning of March, 1882, I saw a honey-bee pay fourteen visits to flowers on four plants growing near one another in our garden; but the insect seemed to have a difficulty in reaching the nectar, and rejected many flowers altogether. In the first week of April, 1883, I observed three medium-sized humble-bees (*Bombus* sp.) visiting freely quite a number of Primrose-flowers in Westley Wood; and on May 1st, in Hyde Wood, Little Yeldham, the day being very warm, I noticed a number of individuals of *Anthophora acervorum* at many flowers. One of these visited the *P. elatiori-vulgaris* many times; another, very unmethodically, visited Primrose sixteen times, Violet five, Primrose one, Violet four, Primrose nine, and Violet once, after which I lost sight of it. I also

observed specimens of a species of *Syrphus* (Dipteron) visiting Primroses, as well as a large black humble-bee with orange-red band, which visited several flowers on three plants of Primrose, and others on Blue Bell, Violet, and *Ranunculus ficaria*. A very large striped bee visited eighteen flowers of Primrose and Hybrid-*elatior*, but I saw it avoid two flowers of true *P. elatior* on one plant. On April 5th last, in Westley Wood, it being a hot day, I was surprised to see a Brimstone butterfly (*Gonepteryx rhamni*) visit five flowers on as many plants of Primrose; I also observed a Small-white butterfly (*Pieris rapæ*) pay a single visit to Primrose. Humble-bees, I believe, fairly often visit Primroses on hot days, but the butterflies perhaps did so on the strength of the proverb that "beggars must not be choosers," there being very few other flowers out so early.

It is perfectly evident, however, that the Primrose differs from its nearest relatives in not depending mainly on bees for its fertilization. On this subject I have obtained one observation which, although it does not settle the matter, yet may perhaps help to do so. There is a small black beetle of about one-sixteenth of an inch long, *Meligethes picipes*, Sturm.,[44]

[44] [For the verification of the name of the beetle (one of the Nitidulidæ) we are indebted to our member Mr. T. R. Billups, who has had large experience as a collector of Coleoptera. Mr. Billups points out that the species is very commonly found in company with *Meligethes æneus* and *M. viridescens* in the flowers of the Compositæ, such as Hawkweeds, Dandelions, &c. Hermann Müller ('Fertilization of Flowers,' Eng. Transl., 1883) gives a list of no less than sixty-three flowers in which species of the genus occur abundantly. Mr. Billups says—"Their food is undoubtedly to a large extent the pollen of the plants, and one or two Continental authorities upon Coleoptera are inclined to consider them carnivorous, feeding upon the smaller insects they meet with in the flowers." Müller notes the very varying habits of the beetles in different flowers; in some he says they feed upon pollen, in others that they lick up the nectar, and of *M. æneus* he observes that he had seen distinctly with a lens this small beetle gnawing the inner surface of the petals and stamens of *Ranunculus lanuginosus*. Mr. Christy's hypothesis that species of *Meligethes* are the principal agents in the cross-fertilization of Primroses is one that must be tested by observation and experiment; but, supposing it to be true, we find then a difficulty in conceiving how the peculiar dimorphic structure of the flowers arose, or even in comprehending

which is very common in the early spring, frequenting, I believe, the flowers of *Ranunculus ficaria* and many other plants, but which is especially partial to Primroses, as Mr. Archer Briggs has already observed. I have found them in Primroses almost whenever and wherever I have looked for them. I have often been surprised at their numbers; in hot weather they seem to be actively engaged in the flowers, and in cold perhaps they enter them for shelter. On some days I have found at least one in nearly every flower examined, while sometimes from seven to ten specimens occurred. It is probable that they enter the flowers in search of nectar, as I have often found them down at the very bottom of the tube; and Mr. Rosling, who has examined the contents of their stomachs microscopically, could find no trace of pollen. It is hard to believe that in entering the flowers these beetles do them neither harm nor good. If harm were done, I presume that the plants would develop some means for keeping them out, such as those employed by other flowers to exclude injurious insects. But whether the beetles accomplish the fertilization of the flowers remains to be proved. New as the idea may be, it is by no means impossible for them to do so. I have taken individuals direct from the flowers, and although they are smooth, shiny insects, I have always found the head, thorax, body, sides, legs, and in fact every part of the insect, covered with pollen. I have not actually observed them flying from flower to flower, as it would be almost absolutely necessary for them to do, but they are well furnished with wings which they use to right themselves when placed on their backs. I have also observed them flying when I have had some in a bottle, and

the necessity for it. If the Primrose be fertilized during the struggles of a small beetle to enter or quit the mouth of the corolla, cross-fertilization would surely be equally well effected were the stamens and stigma both placed at that spot. Mr. Christy's careful observations seem to go far in refutation of the prevalent idea that bees or Lepidoptera fertilize this common plant. Is it possible that the dual condition of Primrose-flowers arose as an adaptation to the visits of some insect which has since become rare or extinct, and that the plant has now to depend upon the chance visits of such minute guests as *Meligethes*?—Ed.]

on hot days a dozen or more beetles, belonging to this species or a very closely allied one, may generally be found in the flowers of the Dandelion or Charlock, which, if taken and shaken into one's hand, readily take wing and fly away. In going down the tube of both forms of flower they have a struggle to pass the anthers and the stigma; and I have seen both l. and s. flowers containing beetles in which the sides of the stigma were well covered with pollen, as if the insects brushed against them. If it should be proved that the beetles are the fertilizers of Primroses, Darwin's explanation will merely have to be modified a little. The *reciprocal* cross-fertilization of the flowers would be as easily accomplished in this way as in any other, for the beetles in passing up and down to the nectary would have precisely the same effect as a bee's proboscis in conveying the pollen.[45] The case stands as follows:—There are three species of *Primula* closely allied, and very similar in the structure of their flowers. We know that two of them (Cowslips and Oxlips) are regularly fertilized by bees, but the little beetles just mentioned so seldom frequent these that after an examination of many thousands of flowers I have come to the conclusion that the beetles enter them rather by accident than by design; and, as it is not known what insects fertilize Primroses, it seems at least possible that these small beetles may be the active agents. Although Mr. Darwin protected his Primroses from the larger insects, these small beetles may have got unobserved through his nets and effected their fertilization, thus accounting for the vastly greater degree of fertility possessed by Primroses over Cowslips under the same conditions.[46]

[45] My cousin, Mr. R. W. Christy, who has observed the number of beetles frequenting the flowers, suggested to me that Darwin's belief in the Primrose being fertilized by nocturnal Lepidoptera is untenable, as there are very few such insects abroad in the early spring when Primroses habitually blossom.

[46] This seems the more probable, as I suppose that in heterostyled plants (especially the long-styled forms) fertilization is impossible, except through the agency of insects.

[Darwin observed that when both were protected by a covering of gauze the long-styled Primrose-plants produced more seed than the s.; and it

Concerning the Cowslip (*P. veris*), I have but few remarks to make. Most people know it is an inhabitant of open places, nearly always growing in meadows or on hedgebanks. I have sometimes seen it extending a short way up the rides or other open places in woods, but never growing under thick cover. It is the latest of the three species to flower. In 1879 I noted that the majority of plants in Essex opened about April 10th; in 1880 about March 21st; in 1881 about April 7th; while in 1882 they opened about the beginning of April, and were over by May 15th. Occasionally it exhibits, like the Primrose, a tendency to flower in the autumn. Mr. Bennett, in the 'Phytologist,' records one blossoming in November, 1846. I saw one out at Chignal on November 5th, 1880, one on March 1st, 1883, and another at Chelmsford on January 7th, 1884; while a friend saw one in Wales on September 15th, 1882. The Cowslip seems to vary but little, seldom producing those "sports" which appear in the Oxlip and Primrose. I have never observed it to bear solitary flowers, or to produce leaves in the umbel, or a foliated calyx; and the petals seldom vary, except in size or colouring. I never heard of *white* flowers; but *red* ones are sometimes met with, although I have only once seen an Essex specimen. This is preserved in H. C. Watson's Herbarium at Kew, and is labelled "Coloured Cowslip with limb of corolla flattened, as were others near it, but of the usual tint. Near Kelvedon, Essex, 1853, E. G. Varenne." The "double-umbel" does not seem to be uncommon, at any rate round Chelmsford; I have seen it also in *P. farinosa*. It consists in a small umbel, generally with fewer flowers than

must be admitted that this fact seems to favour the idea that in spite of care small insects may still have found an entrance. In the long-styled form the stigma generally almost closes the throat of the corolla-tube, and in struggling past it a beetle would most probably rub off its adhering pollen-grains; but in the short-styled form, where the stigma is placed lower down in the tube, there appears to be a freer passage, and the abrasive process would not so certainly take place. Moreover, in the short-styled flowers, the anthers being at the top of the tube, the beetles, if pollen-eaters, would congregate there, away from the lower-placed stigma.—Ed.]

the lower one, growing up on a short stalk out of the middle of the principal umbel.[47] I once found two plants growing together on a bank, and bearing five or six such umbels. Occasionally specimens may be found growing in the open bearing fasciated stalks, with an enormous number of flowers. Of course these are not the result of "stimulation," although one, which I gathered this spring on a roadside from which a number of bushes had been cut, may have been so produced. The peduncle was of great thickness, and bore 164 flowers and buds, with others on several small stalks growing up around the main one. In the centre of the umbel and on the top of the peduncle there was a small round hole, the shape of an inverted cone, and into this hole some of the inner buds had been forced by the pressure of the rest. I have seen several others of almost equal size growing in fields at Chignal, and one which grew in my garden in 1883 bore 173 flowers; while in the British Museum is a specimen of Edward Forster's which had been cultivated in the garden at Boconnor Parsonage. It has a flat stalk about eighteen inches long, one inch broad, and bearing, I believe, quite 250 flowers.

Although the flowers are pendant, the capsules are perfectly erect; they are somewhat round, and much shorter than the calyx.

Mr. Varenne, of Kelvedon, writes me as follows:—"We have two distinct-looking forms of *P. veris* growing hereabouts; (*a*) a hedge-bank plant, very tall, with long leaves and small corolla-limb; (*b*) a much more dwarf plant, growing in meadows, with short leaves, and expanded corolla-limb." These two races are certainly noticeable in many other parts of the county, but I suppose they are attributable to the different situations in which the plants grow. The form "*a*" flowers, I believe, some days earlier than "*b*."

Mr. Darwin says ('Forms of Flowers,' p. 56):—"The Cowslip is habitually visited during the day by the larger humble-bees (viz., *Bombus muscorum* and *hortorum*), and at night by moths, as I have seen in the case of *Cucullia*."

[47] As is normally the case in *P. japonica*.

I have been unable to observe this myself on more than one or two occasions, although I have often watched carefully in places where Cowslips grow in abundance. In April I saw a specimen of *B. venustus*, Sm., visit several flowers on a cluster near Saffron Walden, and in May an individual of *B. scrimshiranus* visited others at Chignal. At Tilbury (near Yeldham) on May 1st last I saw a Brimstone butterfly searching for flowers on a roadside bank. It visited a Cowslip, took a considerable flight, and then returned and visited ten more Cowslip-flowers in succession, after which I lost sight of it. Thus I have seen this insect visit all our Essex species of *Primula*.

As Mr. Darwin says (p. 21), the flowers of the Cowslip when insects are altogether excluded are perfectly sterile. On April 28th I transplanted some plants with unopened flowers to my garden, and covered them with gauze. They remained open for want of fertilization an unusually long time, *viz.*, to nearly the end of May. At the end of June I found that six s. plants bore ten umbels, and six l. plants bore eight, but not a single seed or capsule had been set in either form. The following year, being uncovered, they all produced an abundance of seed.

Of the Oxlip (*P. elatior*, Jacq.) but little remains to be said, as I have already spoken of it largely in other places. Its time of flowering is intermediate between that of the Primrose and the Cowslip, although it varies of course a little according to the season.[48] The tendency to flower in the autumn is

[48] Thus on March 18th, 1880, I found it just coming into flower in a wood at Tilty; by the beginning of April the flowers had reached perfection; by the 23rd many had withered; and by the end of the first week in May they were almost entirely over. The spring of 1881 was a very late one. On March 17th I could only see one or two flowers open, and on the 27th scarcely any in a wood where there were plenty at the same date in the previous year. On April 6th I noted them as being "backward and stunted—not nearly full out," though they reached perfection at the end of March the year before. Warm weather then came, and they were at their best about the 20th. Then cold winds and snow withered up many, though some, I believe, remained out until the middle of May. In 1882 the spring was a very forward one. As early as the 12th of February I found a plant bearing single flowers partly open,

very slight in the Oxlip, but I found two umbels out near Walden on Nov. 18th, 1882. I have never heard of either red or white flowers.

There are several slight, yet constant, characters by which I believe this plant may invariably be distinguished from the Hybrid Oxlip, and other forms and species; and I fully agree with Mr. Darwin, who remarks ('Forms of Flowers,' p. 72)—"In general appearance it differs so much from the Common Oxlip (Hybrid) that no one accustomed to see both forms in the living state could afterwards confound them; but there is scarcely more than a single character by which they can be distinctly defined, namely, their linear oblong capsules, equalling the calyx in length." This is certainly a good means of distinction, although it seems to have been omitted from 'English Botany.' The capsules of the Cowslip and Primrose are, in length, seldom more than $1\frac{1}{2}$ times their breadth; while in the Oxlip they are often 3 or $3\frac{1}{2}$ times as long as they are broad, and their tops project nearly one-third of their length beyond the calyx.[49] Nevertheless the shape of the capsules varies a little, some being shorter and thicker, while others are longer and narrower; but I have not been able to connect these differences with the two forms. When compared with the Hybrid Oxlip, the following differences are most noticeable:—the peduncle is more slender, the calyx fits far more tightly round the corolla-tube, the shape of the umbel is far more graceful, the petals are widely funnel-shaped, and not saucer-like; while they do not overlap at their edges, as those of the other species often do. The petals are of a pale buff-colour, totally distinct from the tint of the other species. The character, however, which I believe to be the most reliable one is the complete absence in the True Oxlip

but this was exceptional. Plenty, however, were open by the beginning of March; by the 25th they were about in perfection. About the middle of April they began to go off, and were over by the end of the month. In 1883 a very few came out at the beginning of March, but, cold weather intervening, the majority did not appear till April, and they were over by the end of the month.

[49] See Ann. Nat. Hist., vol. ii. (1848), pp. 164—166; also Trans. Edinb. Bot. Soc., iii. (1850), pp. 69—70.

of those folds or boxes in the neck of the corolla which are present in all the other species and hybrids. Mr. H. C. Watson, writing in the 'Phytologist' for May, 1844 (vol. i., p. 1001), says:—"I am induced to point out a character of the Bardfield Oxlip (*P. elatior*, Jacq.), which will probably afford a certain distinction between it and the spurious Oxlips. In the Primrose and the Cowslip, and all their varieties, a circle of scale-like folds[50] surrounds the orifice of the tube of the corolla. These folds are absent from *P. elatior*." Mr. Darwin quotes Henry Doubleday to the effect that *P. elatior* is a true species, having been cultivated for a quarter of a century without change. To this I can only give testimony that I have seen many thousands of capsules, every one of which seemed to be producing its full complement of seed, and I have never seen anything leading me to believe that it was a hybrid or a spurious species. On the contrary (with the exception of those "varieties" which I have already treated of, most of which seem to be due entirely to "stimulation," and which would be better termed *monstrosities*), I can say with perfect confidence that the features of the plant are almost absolutely constant when not hybridized, never varying materially either towards the Primrose or the Cowslip. I have seldom seen a specimen respecting which I have had a moment's doubt, and I say this after an examination of an enormous number of plants during the last seven years. It is perfectly true that the shape of the leaves, the size of the umbels and of the flowers, and the colour of the latter vary a little, but these generally accompany the varying sizes of the plants, which are again regulated by the favourable or unfavourable situations in which they grow.

Mr. Bentall, writing in the 'Phytologist' on April 16th, 1846, says:—"In this locality (Grinstead Green) *P. elatior* is accompanied by a profusion of *P. vulgaris*, and, where the two plants are growing intermixed, I have observed specimens which I have no hesitation in pronouncing to be hybrids

[50] This word was printed as "glands," but in vol. ii., p. 527, Mr. Watson points out the misprint.

between them. The circumstance has a little surprised me, knowing that most of the stations where *P. elatior* occurs are characterised by an entire absence of *P. vulgaris;* and although the former is frequently accompanied by *P. veris*, I have never seen or heard of an example of hybridity between them."[51] With this exception, I believe *P. elatior* has not previously been recorded as hybridizing with the other species in this country. I first met with plants which I considered to be hybrids between the Oxlip and the Primrose several years ago, and have seen them every spring-time since. I have met with them abundantly in Grim's Ditch and Madghob's Wood, near Saffron Walden; in the Hyde Wood, Little Yeldham; in lesser quantities in several other woods; and with introduced Primroses in a garden at Bardfield. All these localities, except the last, are on the edge of the Oxlip district, where the plants are mixed with Primroses, the latter plant, as already stated, being absent from the district occupied by *P. elatior*. It may be objected that I have not proved by cultivation and experiment as did Darwin,[52] that my plants were hybrids, but I think the following reasons are sufficiently conclusive:—(*a*) they never occur in the interior of the *elatior*-district, but they grow on the verge of that district where the Oxlips intermingle with Primroses; (*b*) I have never seen similar specimens growing away from the Oxlip district; (*c*) whenever found, I have seen both parents growing within a few yards; (*d*) they are in all respects intermediate between the two forms; (*e*) they are certainly not Hybrid Oxlips (*P. veri-vulgaris*), from which they are at once distinguished by their colour, general appearance, and the tight-fitting calyx—the calyx in the Cowslip and most of its hybrids being widely inflated; (*f*) their colour, size, smell, non-overlapping petals, and contraction of calyx are intermediate between the parents; (*g*) among them sometimes may be found examples

[51] Darwin states that *P. elatior* and *veris* have been known rarely to hybridize in the Alps. There are specimens at Kew of *P. elatiori-vulgaris* from "Le Mont sur Lausanne, 13-4-77," and of *P. elatiori-veris* labelled "Sivirriez, near Fribourg, and Rennaz, Vaud, 1874 and 1877."

[52] I regret that a number of experimental intercrossings were rendered useless from a cause over which I had no control.

approaching more nearly to one than to the other. I have always observed these hybrid plants in recently-cut woods, where, doubtless, they are produced by the agency of insects which indifferently visit both forms on the removal of the cover. The only doubt that remains is, whether they can be a caulescent variety of the Primrose "stimulated" by the cutting-down of the woods. I think not, because—(*a*) I never observed that cutting down a wood "stimulated" Primroses in this direction; (*b*) if it did, the stimulus would have had time to pass off in many woods where I have found them; (*c*) Primroses never produce such plants away from *P. elatior;* (*d*) the eye-spot and general appearance is not that of the pure Primrose. I have never observed whether or not the anthers produce abortive pollen. The umbel, as might be expected, is a somewhat irregular one, the flowers not drooping; and solitary flowers are not numerous among them. I am perfectly convinced in my own mind as to their hybrid origin, and the only thing that surprises me is their abundance. In Grim's Ditch Wood I estimated that they composed 15 or 20 per cent. of all the *Primula* plants in the open part. In the Hyde Wood I particularly noticed that they were only to be found in the few spots where *P. elatior* grew sparingly, and on these spots the hybrids composed about 60 per cent. of all the *Primula* plants, but this was only in very limited areas of a few square yards each. From this it is evident that in England the Oxlip and the Primrose in a wild state cross very freely with one another when intermixed.[53] With the Cowslip, which abounds throughout the whole of the *elatior*-district, the case seems to be different. On two occasions only have I found it hybridizing with the Oxlip, although, as already stated, careful search was made in places where both grow abundantly intermixed. The first time was in Madghob's Wood, on April 23rd, 1883, when I found a cluster of five or six plants growing near the edge of the grown-up part of the

[53] I have supplied the Kew Herbarium with specimens of this hybrid (*P. vulgari-elatior*, Gren., *P. acauli-elatior*, Muret.), and also with some of the more striking varieties of *P. elatior*. To the Royal Gardens I have sent roots of this hybrid and of that produced with the Cowslip (*P. unicolor*, Lange, *P. officinali-elatior*, Muret, and (?) *P. tommasinii*, Gren.).

wood. In their leaves, the wide inflation of the calyx, the yellow colour of their petals, and the fairly well-defined eye-spot, they seemed to be intermediate hybrids, but they were flowering very feebly. In the second instance the plant was a large, healthy, free-flowering one, which in its nature evidently took most after the Cowslip, as might be expected from its growing on a hedge-bank. The flowers were too large and faintly-coloured for a pure Cowslip, and as I saw no Primroses within miles, but abundance of Oxlips in Wethersfield Wood about 100 yards off, I concluded it was a cross between them. Presuming this surmise to be correct, the facts I have brought forward show that all our three common Essex species will hybridize the one with the other.[54]

Numerous insects appear to visit the Oxlip. I have observed no less than eight or ten species in the act of doing so, but it is on bees that the plant relies mainly for its fertilization. *Anthophora acervorum* is the bee which oftenest visits the flowers. The honey-bee, and a large striped humble-bee (*Bombus scrimshiranus*, Kirby) are also very frequent visitors. I have also seen *Bombus muscorum*, Latr., at work, and several other species of *Bombus*. I have sometimes observed in the flowers the small beetle, *Meligethes picipes*, previously described; and on one occasion a specimen of the Brimstone butterfly was a visitor. Not unfrequently a dipterous insect was seen, its long proboscis and hovering flight apparently enabling

[54] On this subject Mr. Baker writes me:—"I suspect that all the numerous named Primulas of this section are mere varieties of our three species, and I have no doubt they all hybridize naturally with one another." He thinks that the following are all probably mere varieties of *P. elatior*:—*P. pallasii*, Lehm.; *P. montana*, Opitz.; *P. perreiniana*, Flugge; *P. fluggeana*, Lehm.; *P. intricata*, Gren.; *P. carpathica*, Fuss.; *P. alpestris*, Schur.; and *P. subarctica*, Schur.

While this sheet was passing through the press I saw, in the garden of Mr. J. H. Tuke, of Hitchin, a plant of *P. elatior* bearing light-red flowers. It was growing near a number of plants brought many years ago from Saffron Walden; but whether it had been induced by cultivation to produce its red flowers, or whether it was a hybrid seedling which had inherited them from a coloured Polyanthus or Primrose parent, I cannot say.

it to suck the nectar, or steal the pollen, while on the wing.[55]

The old flower-stalks become dry, and remain on the plant until the following year. On April 3rd last I found a great number still standing from the previous spring in Peverill's Wood. The capsules were as usual perfectly erect, although the flowers are pendant; and they still held the majority of

[55] [Prof. Hermann Müller, writing on *P. elatior*, says ('Fertilization of Flowers,' Eng. Transl., 1883, p. 384) that *pollen-collecting bees* are only able to secure their pollen from the *short-styled flowers; they learn to recognise the long-styled plants at a distance, and to avoid them; and thus never perform cross-fertilization, but very often self-fertilization.* He gives the following list of twelve insect-visitors to the plant:—Apidæ: *Bombus hortorum*, honey-sucking and collecting pollen, very abundant; *B. silvarum*, sucking normally; *B. lapidarius*, do.; *B. confusus*, do.; *B. terrestris*, "makes a hole in the corolla-tube, a little above the calyx, sometimes biting it with its mandibles, sometimes piercing it with its maxillæ, and so reaching the honey with its tongue. (I have sometimes seen this bee, before boring the flower, make several attempts to reach the honey in the legitimate way—this observation is of interest, as proving that the bee is not guided by instinct to the plant adapted for it, but that it makes experiments, and gets its honey where and how it can)"; *Osmia rufa*, *Apis mellifica*, "I saw both these species thrust their tongues into several flowers, and then abandon the plant"; *Anthophora pilipes*, sucking normally and collecting pollen, very abundant; *Andrena gwynana*, collecting pollen on the short-styled form, abundant; "it holds the anthers in the mouth of the flower with its fore feet, bites the pollen loose with its mandibles, and sweeps it with the tarsal brushes of the mid-legs into the collecting hairs of the hind legs. It visits the long-styled form also, but flies away immediately; not, however, without performing cross-fertilization in the momentary visit. *I have never seen a pollen-collecting humble-bee alight on long-styled flowers; it seems to recognise them at some distance, and to avoid them.*" Diptera: *Bombylius discolor*, sucking, abundant; *B. major*, much less frequent, probably in most cases unable to reach the honey. Coleoptera: *Omalium florale*, abundant, creeping about in the flowers.

We abstract the above very interesting notes of Müller's at some length for the purpose of calling the attention of botanists to the light the habits of pollen-eating bees appear to throw upon the puzzling fact observed by Mr. Christy, *viz.*, that l. are the most numerous, while s. are the most fertile (see *ante*, pp. 162 and 167-8). Müller's observations seem to show that many pollen-gathering bees habitually pass over the l., but take abundance of pollen from the s.; the result being that while the l. would retain their

their seeds, although the new crop of seeds was already beginning to form. This habit of the Oxlip is an exceptional one, I believe; most plants in this country get rid of last year's seeds before they begin to produce another crop. A shake will throw the seeds out of the capsules, and very likely distribute them to the distance of a foot or so, where they will have a far better opportunity of growing than if the capsules were pendant like the flowers and merely threw the seed down on to the plant. The clusters of capsules form very pretty objects.

Our three species secrete plenty of nectar, which in hot weather may often be tasted on pulling out the corolla. They all emit fairly powerful scents, which are much of the same kind, yet quite distinguishable. That of the Oxlip may be somewhat likened to the smell of peaches or apricots.

The Hybrid Oxlip is easily distinguished from the True Oxlip. Its extremely variable nature shows that it is not a true species, and Darwin's elaborate experiments ('Forms of Flowers,' pp. 63–70) have proved conclusively that it is a hybrid between the Cowslip and the Primrose. It occurs more or less commonly in all places where both these grow

full complement of pollen, the stock of the s. would be much diminished. Thus nectar-seeking insects which effect cross-fertilization would necessarily carry more long-styled pollen to s. than short-styled pollen to l., and consequently the chances of the s. being cross-fertilized would be the best. Also, inasmuch as the majority of fertilizations would be the result of the action of long-styled pollen upon the ovules of s., it is conceivable (assuming the prepotency of the male element in plant-fertilization) that the "long-stylism" of the pollen would be impressed upon the resulting seeds, leading eventually to a slight increase in the number of l.; while, owing to the "artificial" selection by pollen-gatherers, as above indicated, the s. would produce the greater quantity of seeds. In this way also we may explain the discrepancy between Mr. Darwin's and Mr. Christy's observations. If our hypothesis be true, the relative numbers of the two forms in any given locality would depend very much upon the presence or absence of species of *pollen-gathering bees*. In places where these insects are common, l. would tend to increase; but where they are rare or absent the numbers of the two forms would become equalized, owing to efficient reciprocal cross-fertilization by nectar-seeking bees.—Ed.]

together, but never where only one grows.[56] Darwin suggests that its frequency in some places may be due to a particular species of moth or other insect which visits both plants, but, until we know more certainly what insects visit either species, this point must remain unsettled. The period at which these Hybrid Oxlips flower is probably very largely regulated by the parent the hybrid most takes after, but I was surprised to see one partaking strongly of the Cowslip nature out as early as March 7th last. They not unfrequently remain in flower until quite the end of May, when all other Primulas are over. This I suppose to be due to their want of fertilization, as many flowers remain out for a long period when fertilization is prevented; but these hybrids, as usual, are to a large extent sterile, and therefore *cannot* be fertilized. The Hybrid Oxlip is, on account of the absence of the Primrose, but very little mixed with *P. elatior* in the district inhabited by the latter, except just on the extreme edge of its area. It is rather strange that in several woods in the neighbourhood of Saffron Walden all the forms (Cowslip, Oxlip, Primrose, Hybrid-*elatior*, and Hybrid Oxlip) should grow. This, the late Mr. Gibson informed me, is the case in Quendon Wood. I have already spoken of Westley Wood and Grim's Ditch Wood, on opposite sides of the Slade Valley. In the former I have for three years running found all the forms, and this year (1883) also in the latter. Primroses abound in Westley Wood, and in several places Cowslips extend a little way up the paths, and as a consequence there are a few plants of the Hybrid Oxlip, while on the edge nearest to Grim's Ditch Wood are a few plants of

[56] The Hybrid Oxlip is said, on good authority, never to be found on the Continent, where the Primrose and the Cowslip do not grow intermixed as with us. Nevertheless there is at Kew a specimen labelled "*P. officinali-vulgaris*, Près Montreux, Vaud, 15-4-75, F.," which seems to be identical with the Essex plant of the same name. Many other specimens which appear to me to be hybrids with *elatior* are arranged with English Hybrid Oxlips (*P. veri-vulgaris*) under the name of "*P. variabilis*, Goup." One such is labelled "Hôtel Byron, nr. Chillon, Avril, '51. Cette plante hybride de la *P. acaulis* et de la *P. officinalis* n'est pas rare dans les environs de Montreux, G. M."

P. elatior. All over the latter wood *P. elatior* abounds; but on the edge nearest to Westley Wood it is mixed with plenty of Primroses and hybrid *elatior*, and also with Hybrid Oxlips produced by the Cowslips growing at the edge. In one meadow at Lindsell *P. elatior* and *veris* grow commonly with the Primrose, the Hybrid Oxlip and *P. elatiori-vulgaris* sparingly near the hedges.

In the early volumes of the 'Phytologist' a fierce discussion raged as to the specific value of the English species of *Primula*, and many experiments were made to prove that they might all be raised from the seed of one plant; but, as Mr. Darwin says, these are all valueless because "heterostylism, not being formerly understood, the seed-bearing plants were in no instance protected from the visits of insects," so that every opportunity was afforded for some of the offspring to be hybrids.

I may here mention that I have noticed in *P. farinosa* growing among the Alps a peculiarity which I believe has not been previously observed, namely, that there is one flower, or occasionally I think two, set generally on stalks a little longer than the rest, and coming from the centre of the umbel, or very near it, which remains out some time—I believe several days or a week—after the others have withered. This may be of the same nature as the "central flower" of the Carrot and some allied Umbelliferæ mentioned by Darwin; but I believe its persistence is not through want of fertilization or because of sterility, as I have seen it produce seeds as regularly as the others. To quote Mr. Darwin ('Forms of Flowers,' p. 8), it "may perhaps be a remnant of a former and ancient condition of the species when one flower alone, the central one, was female, and yielded seeds." I have once observed an instance of the same thing in the Polyanthus, and once in the garden Auricula.

In conclusion, I would venture to suggest that, should this paper fall into the hands of any Continental botanist of experience in this genus, it would be very interesting to English botanists to learn whether *Primula elatior*

hybridizes so freely, is so subject to stimulation and consequent monstrosity, or in any way differs, on the Continent of Europe, from what it is with us; also whether the Hybrid Oxlip (*P. veri-vulgaris*) ever really occurs out of England.[57]

[57] The author wishes to acknowledge the very great assistance in various ways which Mr. William Cole has most kindly rendered to him while the foregoing paper was passing through the press.

VIII.

Report of the Committee appointed to investigate the Ancient Earthwork in Epping Forest, known as the "Loughton" or "Cowper's" Camp.

Drawn up by the Honorary Secretary, with the assistance of the other Members of the Committee.

Plates III. and IV.[1]

[The Club having raised a Fund for the exploration of the Loughton Camp (a list of subscribers to which, including a grant of £10 from the British Association, will be found in Appendix No. 2 to the present volume), a careful examination was made during the summer of 1882 by a Committee appointed by the Club for that purpose. Four members of that Committee, *viz.*, Mr. R. Meldola, F.C.S., General Pitt-Rivers, F.R.S., Mr. Worthington Smith, F.L.S., and Mr. William Cole having been appointed a separate Committee by the British Association for the Advancement of Science, were requested to draw up the following Report, which was read by Mr. Meldola at the meeting of the Association at Southport, the paper being illustrated by the exhibition of the relics found in the ramparts, and by means of large plans and sections prepared by Mr. H. A. Cole. The Report was also read at a meeting of the Essex Field Club held at Buckhurst Hill on September 29th, 1883. The report is printed in the 'British Association Reports' for 1883, pp. 243–252. Full particulars as to the mode of working, names and attendances of the Committee, and various local details, will be found in the 'Journal of Proceedings,' vol. iii., pp. li.–lv. It was intended to add to this report an account, with bibliographical references, of earthworks of a similar nature which have been explored in various parts of England, but we are compelled from want of space to postpone this for the present.—Ed.]

In ancient times an immense forest probably covered the greater part of the county of Essex, and, as a remnant of this vast tract of woodland, the present Epping or Waltham

[1] [These plates were lithographed for the British Association 'Reports,' and the Club is indebted to the kindness of the General Committee of the Association for copies at the cost of paper and machining.—Ed.]

Forest possesses very considerable interest to the naturalist and antiquary. Although in the progress of agriculture the county generally has become highly cultivated, the stringency of the old forest laws, and the various rights of cattle-feeding and wood-cutting in more recent times, have effectually combined to check enclosures and clearing, and to preserve to Epping Forest many of the characteristics of a primitive woodland. The soil in most of the woods has remained undisturbed within historic times, except in a few spots where local gravel-pits have been opened. It is not surprising, therefore, that relics of former conditions of life should still exist in the Forest, undefaced except through the action of natural agencies; but until very recently the district has not received from archæologists the attention it deserves, and it is more than probable that further traces of prehistoric occupation will yet reward the persevering explorer. At the present time the Forest is known to contain two ancient earthworks or camps, which are of more than ordinary interest, being perhaps the best-preserved examples of such structures in the immediate neighbourhood of London. One, locally called "Ambresbury," "Amesbury," or "Ambers" Banks, is situated in the Forest about 1½ miles south-west of the town or village of Epping Street, and about a hundred yards to the right of the road to Epping, which was made early in the sixteenth century. This position rendering it easy of discovery, the Ambresbury Camp has long been known, and the meagre and unsatisfactory details usually given of such remains are to be read in the local histories. In 1881 the Essex Field Club carried on some explorations at Ambresbury Banks, a report upon which, drawn up by General Pitt-Rivers, was read at the York Meeting of the British Association,[2] and published *in extenso* in the 'Transactions' of the Club (vol. ii., p. 55), with plans of the camp constructed by Mr. D'Oyley, and coloured figures of the objects found. These relics, consisting of small fragments of very rude pottery and a few flint "flakes," determined the camp, in the opinion of General Pitt-Rivers, to be of British

[2] Brit. Assoc. Reports, 1881 p. 697.

or Romano-British construction, but the data obtained were insufficient to fix the age of the entrenchment with greater precision.

The second entrenchment, now called the "Loughton" or "Cowper's" Camp, remained unknown until it was discovered by the acumen and perseverance of Mr. B. H. Cowper. Mr. Cowper thus recounts the circumstances attending his recognition of the camp:—"In the course of my researches in the Forest, I came, in the summer of 1872, into the neighbourhood of Loughton. There it was that I suddenly detected what appeared to be a portion of a moated enclosure. A short investigation was then all that I could make, but I was convinced of the reality of the conjecture. I made some inquiries, but failed to discover any record or local knowledge of a camp in that portion of the Forest, and there the matter ended for the time. In 1875 I returned, and after several efforts managed to complete the circuit of the camp, which was a difficult operation. I gave as much publicity as possible to the discovery, and in addition went over all the ground between the Loughton Camp and Ambresbury Banks. Friends took an interest in the matter, and foremost among them was Mr. W. D'Oyley, who rendered the greatest service and accomplished a complete survey of both the ancient earthworks." By means of this discovery Mr. Cowper made an important addition to the knowledge we possess of the Archæology of the Forest district; and in his various papers, the titles of which are here recorded, he gave a careful description of the earthwork and its surroundings, and compared it with the neighbouring Ambresbury Banks. Mr. Cowper's writings on the subject are as follows:—(1) "Notes on an Entrenched Camp in Epping Forest, with plan by Mr. D'Oyley"; read at a meeting of the Royal Archæological Institute, November 5, 1875;[3] (2) "Ancient Earthworks in Epping Forest";[4] (3) "Ancient Camps in Epping Forest, with plans by William D'Oyley, of Loughton"; a pamphlet published by the Committee of the "Epping Forest Fund" in

[3] 'Archæological Journal,' vol. xxxiii., p. 88.

[4] *Loc. cit.*, p. 245.

1876, and now rare; (4) "Epping Forest and its Ancient Camps" (with woodcut).[5] We gladly acknowledge our indebtedness to these papers for many details. Mr. D'Oyley's labours in the delineation of the two camps call also for grateful recognition, inasmuch as they materially aided the explorations which were afterwards undertaken.

The Loughton Camp is situated about a mile north of the village from whence it takes its name, and about two miles south-west of Ambresbury Banks. It is placed in the depths of the Forest, the trees surrounding and covering it being principally beech and oak; some very ancient specimens of the former tree actually grow upon the ramparts, and many old hollies are to be found both within and around the entrenchments. Its circumference is about 800 yards, giving a contents of between eleven and twelve acres; the two known Forest camps being very nearly of a size. The construction of the camp is also very similar to that of the Ambresbury entrenchment, an outer broad ditch having been dug, and the earth so obtained thrown up on the inside to form a rampart. In the report on the Ambresbury Banks allusion was made to the somewhat irregular lines of the fortification as contrasted with those of camps of known Roman origin. In the Loughton Camp strict symmetry of proportion has been completely disregarded by its constructors, and there are scarcely any defined angles (see Plate III.). The form of the camp is that of an imperfect oval, and the lines of the rampart appear to follow and to have been controlled by the natural contours of the ground. It has suffered to a much greater degree than Ambresbury Banks from the effects of age and denudation. In many places the burrowings of foxes and rabbits have caused much damage, increased possibly, in some instances, by foresters in digging out the animals, or even in removing sand in very modern times. In one place in particular, on the western side, the bank and trench have nearly disappeared, the soil having apparently literally tumbled down the slope of the valley, a result probably due to natural agencies, this being a very

[5] 'Cassell's Family Magazine,' vol. iii. (1877), p. 153.

exposed part of the fortification. We are sorry to report that, in the course of the construction of a recently designed "Green Ride" through the Forest, a considerable portion of the western glacis has been cut away, and the original appearance of the rampart at that spot completely destroyed.

The position of the camp is remarkable; and, considered from a military point of view, it is perhaps the most advantageous in the whole Forest district. It occupies the southern headland of an elevated plateau, many parts of which are densely wooded. From the southern side of the camp an extensive view may be had looking towards the south-east, bounded by the Kentish hills beyond the Thames. The Lea Valley to the west is shut out by the long ridge forming High Beech, which is higher than the ground occupied by the camp. At the northern angle of the camp the elevation is about 310 feet above the Ordnance datum. The ground gradually trends away towards the southern rampart, and then suddenly dips down to Debden Slade, a low marshy valley distant about 1000 feet to the south, and the level of which is only 160 feet above datum, showing a fall of about 120 feet from the southern aspect of the camp, or 150 feet from the higher plateau ground at the northern end. From the western side the ground descends even more abruptly to form a smaller valley, the levels showing a fall of about 70 feet. This valley falls to the south to join Debden Slade. From the north-west corner of the camp the higher ground forms a headland to this valley, and is continued for a distance equal to about half the length of the camp into a spur towards the south. This tongue of land, being some 10 feet higher than the western rampart, and running almost parallel with it, may possibly have been originally included in the plan of the fortification; but any evidences of entrenchment have probably suffered so much from recent gravel diggings, that no safe conclusions can be drawn therefrom. Mr. Cowper, however, thought he could trace a lower trenching round the head of the valley, continuing for some distance along the crest of the spur.

The high plateau ground, from which this spur springs, is

LOUGHTON CAMP, EPPING FOREST.

PLAN.

Illustrating the Report on the Ancient Earthwork in Epping Forest

Trans: Essex Field Club. Vol. III Plate III

NATURAL HIST

continued round the northern and north-eastern corners of the camp. The ground then descends by the eastern side into a swamp at the south-east corner, and eventually trends away into the deep valley, Debden Slade, before mentioned, the rampart itself sweeping with a gentle curve until its outlines are lost in the slopes of the morass.

This little "morass" (which is a piece of true bog-land, containing *Sphagnum*, *Hypericum elodes*, and other marsh-loving plants) occupies a small valley, which leads up into the interior of the camp. At the spot where the bog seems to originate is a small circular pit, which has every appearance of being a *water-well* of artificial construction. At present, however, we have no direct evidence to connect this well with the original makers of the camp. It is now choked with leaves, &c., but it still appears to supply water to feed the bog, the quantity being largely augmented in winter and spring by the surface-drainage from the higher ground at the northern part of the camp.[6] The ridge of ground on which the rampart runs somewhat contracts the limits of the bog at the north-west corner of the camp, and a little outside the line of entrenchments a bank can easily be recognised running across the morass, leaving a narrow "gate" or floodway towards the east. This bank is perhaps the remnant of an ancient *dam*, by which a head of water could have been retained in the interior of the camp for the use of the inhabitants, a constant supply being furnished by the artificial "well" before noticed. These statements must be put forward somewhat hypothetically; no cutting has yet been made through the "dam," nor has the "well" been explored, and consequently the evidence is wanting which would conclusively prove these structures to be coeval with the camp itself. But they are, nevertheless, very interesting, and cannot be passed over in any description of the place.

Two well-defined, and perhaps old, entrances exist at the northern end of the camp, through one of which a "driftway"

[6] [Since the report was written we have discovered another pit or well in the ravine to the west of the camp, which appears to be similar to that mentioned above.—Ed.]

runs—a very hard and good path, which leaves the camp by an outlet at the southern slope to descend to Debden Slade, and so to Loughton. A good and old path, branching out from the first, runs outside the northern and eastern ramparts, also to Loughton. The three inlets to the camp appear to be ancient, but at present we have no means of fixing their age relatively to the ramparts.

Several *pits* of varying size exist in the camp, and they are numerous on the high level ground, stretching from the head of the little valley on the west round the northern aspect of the ramparts. It is possible that some of these pits may owe their origin to the exertions of sand-seekers; but many of them must be of considerable antiquity, as they are densely overgrown with trees, and we are disposed to think that these at least may have been constructed by the occupiers of the camp, and have had some connection with their habits of life. The regular circular form of some of these pits, and the distance of the site of the camp from any high road (for the present Epping New Road is, of course, very modern) by which vehicles could reach this densely-wooded district, are circumstances sufficient to throw grave doubt upon the suggestion that they were made by gravel-diggers. A cutting was made in one of the pits within the camp; and in the silt, about two feet down, an artificial black flint flake, perfectly unweathered, was found (No. 38). It is hoped that some further examination of these pits may be made, pending which any hypotheses as to their age or probable uses must necessarily be little more than guesswork.

Mr. Cowper mentions some banks on the ground between the Ambresbury Banks and Loughton Camp, and similar works have recently been detected on the high ridge by the "King's Oak," to the west of the Loughton Camp. Owing to the denseness of the Forest, an accurate survey of these banks would be somewhat difficult, and it has not yet been attempted. We are therefore not in a position to describe them more definitely; but they are certainly artificial, and we think they deserve a thorough examination. Mr. D'Oyley also directed our attention to a somewhat remarkable con-

figuration of the ground at one spot in the deep valley to the south-east of the camp. The footpath leading thither from the camp is, at almost its lowest point, flanked by several very "mound-like" ridges of soil, densely covered with vegetation. A section was cut through one of these, but no signs of artificial construction were discoverable. It is probable that they are purely natural formations, caused by the erosive action of the surface-water flowing down rapidly from the higher ground which the camp occupies in sufficient quantity and force to wear away the lighter soil, and so leave these ridges of denser clay standing boldly out above the general level.

The above sketch comprises nearly all the information at present in our possession concerning the external features and natural surroundings of the Loughton Camp, and we now proceed to detail the results of the diggings into the ramparts. Permission having been granted by the Epping Forest Committee of the Corporation of London, the work was commenced on May 29th, 1882, and continued until June 14th, the removal of the earth being very carefully watched by members of the Committee, under the direction of the Hon. Secretary, Mr. W. Cole, Mr. W. D'Oyley also again kindly giving his services as Surveyor. The mode of working, both in theory and practice, was so fully explained by General Pitt-Rivers in his report upon Ambresbury Banks,[7] that it is unnecessary to repeat the details here. Sections were cut through the rampart and ditch so as to expose the "old surface line," or the original floor of earth upon which the soil dug out in making the fosse was heaped by the constructors of the camp to raise up the ramparts. The earth being generally of a more sandy nature than at Ambresbury Banks, the sieve could be freely used, and each spadeful was sifted on its removal and carefully examined for relics, the position of each object found being registered on working drawings of the cuttings. The contract for the work was taken by Mr. Cuthbert, of Loughton, and a word of praise is due to our four workmen, who displayed great care and in-

[7] 'Transactions Essex Field Club,' ii., p. 55; and Proc., ii., xxviii.

telligence in the somewhat tedious and delicate task set before them.

The positions of the cuttings are shown on the plan of the camp (Plate III.). The first was 12 feet in width, and it was carried from the foot of the silting of the interior slope on for 80 feet through the rampart and ditch to the counterscarp. The camp at this part has suffered severely from denudation, owing to the light nature of the soil. As will be seen by an inspection of the plan of the cutting, the present height of the rampart is only about 5 feet 6 inches above the "old surface line," and the ditch is filled up with silt to the depth of about 6 feet. In this first section the silt was so similar in appearance to the undisturbed earth that the outline of the fosse could not be followed out with any certainty, and even the escarp was very difficult to trace.

The following is a catalogue of the objects found in the first cutting, the position of each being carefully indicated by a number on the plan of the section (Plate IV., fig. 1). The horizontal measurements were taken from a post driven into the ground at the point where the silting of the interior slope seemed to end,[8] and the vertical positions from the present surface of the rampart; everything being, of course, projected on one vertical plane:—

No. 1. A small black characteristic flint flake, with good "bulb of percussion" and three "facets." Found beneath the silt at the foot of interior slope, with charcoal and burnt stones, a considerable quantity of which was turned up by the spades from the "old surface line" spit for about 20 feet from the commencement of the cutting. Near a deposit of charcoal three flint flakes (No. 2), and two "cores" from which flakes had been struck were found.[9]

[8] [This point is indicated on the sections by the letters "B.M." (= Bench-mark), and the heights of the various spots above sea-level are given in feet both in the plan and sections. Levels were carried by Mr. D'Oyley from the Ordnance Bench-marks in the Epping New Road across the valley into the camp, and so down into Debden Slade.—Ed.]

[9] [For an explanation of the distinctive characters of artificial flint flakes, and the method employed by their makers in producing them, see Mr. Worthington Smith's paper, *ante*, pp. 136-138.—Ed.]

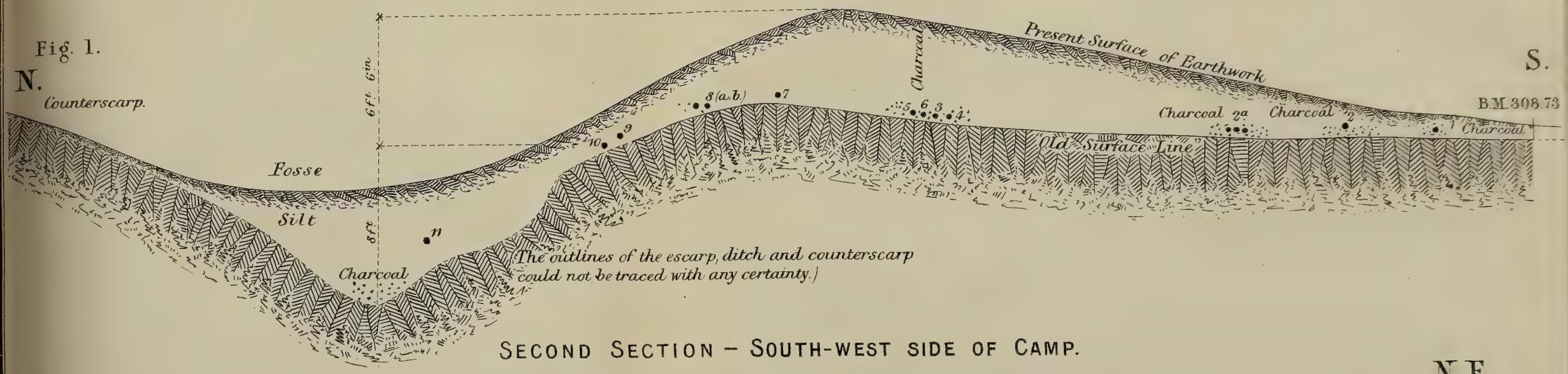
LOUGHTON CAMP, EPPING FOREST,

SECTIONS THROUGH RAMPART.

Position of Objects found projected on one vertical plane.

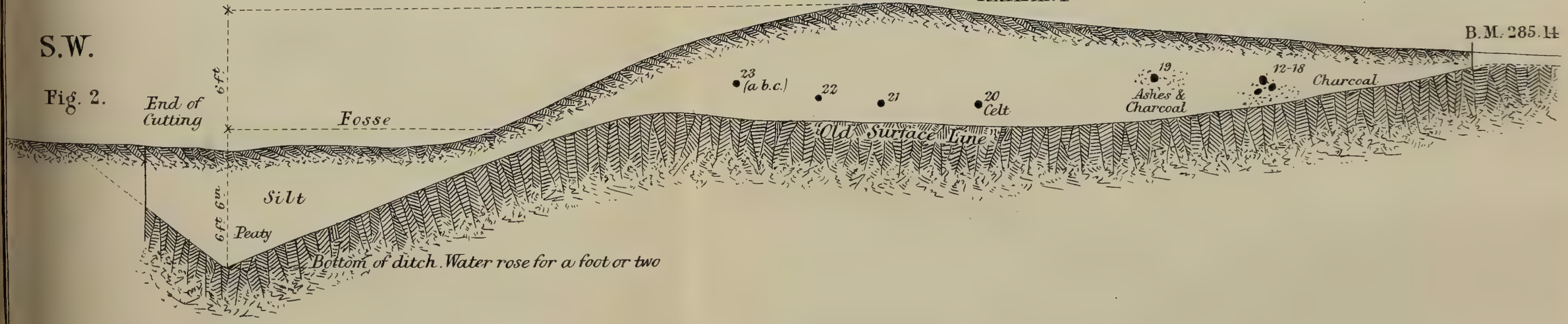
FIRST SECTION – NORTH SIDE OF CAMP.

Fig. 1.



SECOND SECTION – SOUTH-WEST SIDE OF CAMP.

Fig. 2.

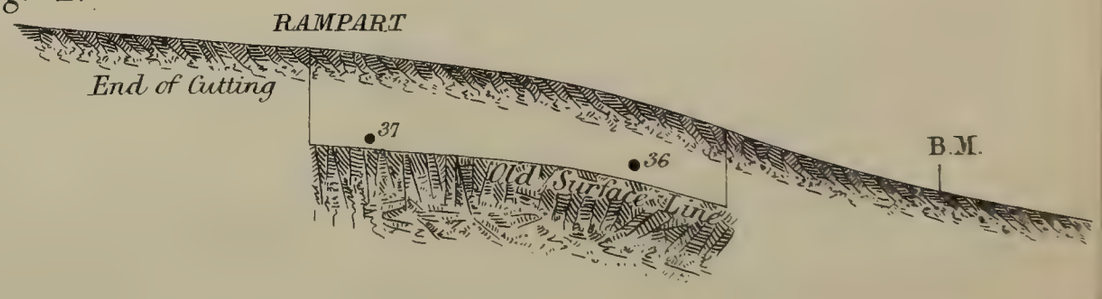


THIRD SECTION – SOUTHERN SIDE.

Fig. 3.

FOURTH SECTION – LONGITUDINAL.

Fig. 4.



SURVEYED FOR THE ESSEX FIELD CLUB,
By W. D'OYLEY. 1882.

SCALE.
One eighth inch to the foot.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

W. Cole, del.

Illustrating the Report on the Ancient Earthwork in Epping Forest.

NATURAL HISTORY.

Nos. 3, 5, and 6. Five small fragments of pottery of very irregular shape, the largest about 2 inches by 1·5 inches, and about 0·5 inch thick. They are dull red in colour, somewhat darker on the smoother or interior surface, and quite blackish in the middle of the paste, owing to imperfect firing. The texture is very coarse, the pottery containing angular pieces of quartz and coloured pebble of comparatively considerable size, with sand. It is decidedly hand-made, and probably of British manufacture. Found on or near old surface line, beneath the crest of the rampart, 30–35 feet from foot of interior slope, with abundant traces of charcoal, &c.

No. 4. Black flint flake, not weathered, with good "bulb" and two "facets." Found with Nos. 3, 5, and 6.

No. 7. "Outside" flint flake near old surface line, beneath crest of rampart.

No. 8 (*a*, *b*). Two good flint flakes, unweathered; the narrower one (*b*) showing distinct marks of use at both ends. Found beneath exterior slope of rampart, about 2½ feet down.

Nos. 9 and 10. Flint "core" and flake with many "facets," both unweathered; found in exterior slope of rampart, about 2 feet down.

No. 11. Flint "core," from which flakes have been struck; found about 3½ feet down in the silt accumulated in the fosse.

The indistinctness of the outlines of the ditch, and the paucity of the evidence above obtained, rendered another cutting necessary, and a new one, 7 feet wide, was commenced on June 8th through the vallum near the south-west corner of the camp. The line of junction between the made earth, silt, and the original surface was here more clearly traceable, and could be laid down with tolerable accuracy upon the plan, except the commencement of the escarp, concerning the exact angle of which some little doubt was felt. On clearing out the fosse, in which 6½ feet of silt had accumulated, its form was found to be pointed, as was the case at Ambresbury Banks. The soil at the bottom of the ditch was quite peaty, and water rose in the cutting for a foot or two. The rampart is now only about 6 feet above the old level of the earth, and its angles are so altered by severe

"weathering" that its original form is not recoverable. In this second section (Plate IV., fig. 2) the following objects were found:—

Nos. 12, 13, and 14. Three good pointed flakes, showing good "bulbs" and several "facets," two of greyish, and one of reddish coloured flint, unweathered. Found with the following:—

Nos. 15, 16, and 18. About two dozen flint flakes, with bulbs of percussion, and some exhibiting one or more "facets," all quite unweathered; found with Nos. 12 and 13, and other flakes and chips, large quantities of charcoal, burnt stones, &c,, near foot of interior slope of rampart, about two feet from surface. There were evident signs of a large fire at this spot, around which the flakes were scattered.

No. 19. Good black flint flake, unweathered; found further in the rampart than the last, but also near abundant traces of charcoal, burnt stones, and ashes.

No. 20. Flint celt, somewhat roughly chipped; about 5 inches long, and 1·5 inches broad, with worked chisel-like ends, and one side chipped into an acute edge, the other being obtuse. Perhaps not finished, but unweathered. Found well beneath the body of the rampart, about 4 feet down (see *infra*, fig. 3).

Nos. 21, 22, and 23. Five flint flakes, with "bulbs" and two or more "facets"; found well under the crest of the rampart, and considerably above the old surface line.

No pottery was found in the second section, although every possible care was taken that even the smallest fragments should not be passed over. General Pitt-Rivers examined the ground and the objects obtained on June 14th, but he and the other members of the Committee were of opinion that further evidence should be sought for before any safe conclusion could be arrived at as to the period of the camp. A third cutting was therefore commenced on Monday, Aug. 14, the spot selected being a good piece of rampart near the south-east corner of the camp. This cutting was 8 feet wide, but, as the escarp was thickly covered with large trees, and the form of the ditch had been determined in the second section,

it was not considered necessary to incur the expense of carrying the trench beyond the crest of the rampart, about 26 feet from the base of the interior slope. The old surface of the earth was readily recognised, and was found to take a deep downward slope, so that the "made earth" of the rampart, although externally apparently greatly denuded, was at least 6 feet thick at the deepest part. The following objects were found in this cutting (Plate IV., fig. 3):—

Nos. 24 and 35. Flint "core," artificial splinter, and flake. Found in interior slope of rampart, about 15 feet from commencement of cutting, and about 2 feet from the surface.

No. 25. Flint "core," found in crest of rampart, about 18 inches from the surface.

Nos. 27 to 32. Twelve pieces of pottery, varying in size from 2·5 inches by 1·5 inches to quite small fragments, all being about 0·3 inch thick. This pottery is of superior quality to that found in No. 1 cutting. It is thinner, harder, and is formed of sandy clay, with no grains of quartz or pebbles in the paste. The colour is dull reddish brown on the surface, but a blackish tint obtains in the centre, an indication of imperfect firing. The curved form of most of the fragments shows that they have belonged to circular vessels, and two of the pieces have "rims," somewhat rudely modelled, which project about 0·1 inch. There are no signs of lathe-turning, and the pottery was doubtless hand-made. A black flint flake was found near No. 30. All the pieces came from well within the interior slope, about $2\frac{1}{2}$ feet from the surface of the rampart.

No. 33. Two flakes, one with three or four "facets"; and No. 34, long slender flake, having good "bulb" and many facets; all unweathered, and from a position well under the crest of the rampart.

A fourth cutting was made longitudinally into the same piece of rampart, at the point where it slopes away into the morass, at the south-east corner, above described. This trench was 6 feet broad, and about 14 feet long (see Plate IV., fig. 4): in it were only found:—

No. 36. A small fragment of pottery, seemingly a portion

of the base of a rudely-made vessel, in quality not distinguishable from Nos. 27–32. Near old surface, about 2 feet from surface of rampart. A small flint flake was found with it, and another (No. 37) further up the cutting, both unweathered.

The number of flint flakes in the rampart of this camp was somewhat large in proportion to the amount of material excavated. Many flakes of a ruder class than those above mentioned, artificial splinters of flint, and rude "cores," were not considered of sufficiently well-marked character to be retained and catalogued.

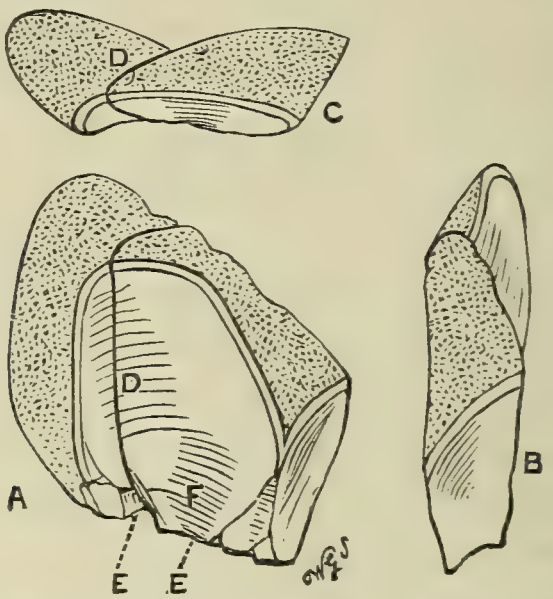


Fig. 1.—Conjoined flakes from Loughton Camp.

The flakes are all as sharp as on the day they were struck off, only one showing signs of use (No. 8 *b*); they all have the "cone or bulb of percussion," are lustrous, and the flints from which they were made apparently belonged to the local gravel deposits. Several exhibit small ferruginous concretions upon them.

The discovery of a large number of flakes, and a quantity of burnt wood and burnt stones in one position in the second cutting (*vide* Nos. 16–18) seems to point (as was first suggested by Mr. H. A. Cole, who was watching the excavations at the time) to the former presence of a camp fire at that spot, around which the men of the camp sat and chipped out their weapons and tools of stone from the rough flints found in the Forest. This idea was confirmed by the fact that

several of the flakes had manifestly been struck off from the same block of flint, and had been left as useless *débris* on the spot where found. After an examination of the flakes from this position, Mr. Worthington G. Smith replaced one flake on to a second somewhat larger one, from which it had been originally struck. This replaced flake is illustrated (one half actual size) at fig. 1.[10]

The front of the two conjoined flakes is shown in the left-hand bottom figure, the side at B, the top at C, and the line of junction at D D. Behind E E are two cones of percussion, one belonging to each flake, and at F is the depression into which the cone of the missing frontal flake at one time fitted. The fractured part of the flint is deep chocolate-brown and lustrous, and the back of the flint is dull ochraceous; the flakes are undoubtedly artificial, and as old as the rampart of the camp.

A few days after, a member of the Committee, Mr. H. A. Cole, on looking over the flakes and conjoined examples, replaced a third flake on to the back of the two as conjoined by Mr. Smith. Fig. 2 represents (one half actual size) the back of the conjoined flakes, and A is the flake replaced by Mr. Cole; the top of this flake was broken at the time when it was struck off; B is the cone of percussion belonging to the flake rejoined by Mr. Cole, and C is a similar cone belonging to one of the flakes rejoined by Mr. Smith.

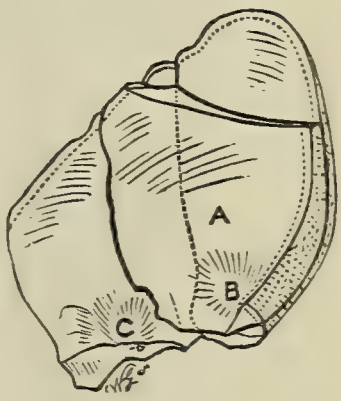


Fig. 2.—Conjoined flakes from Loughton Camp.

Among the flakes was a rude but cleverly chipped flint chisel or celt (No. 20), not polished in any part, but exhibiting traces of the original "crust" or "bark" of the flint in one or two positions. This instrument is of somewhat remarkable form, one side edge being acute, and the other flat; and some doubt exists as to whether it was really intentionally chipped into its present shape, or whether it is simply unfinished on

[10] [For the figures illustrating this Report the Club is indebted to the continued kindness of Mr. Worthington G. Smith.—Ed.]

one side. Mr. Smith remarks—"If this instrument is really a chisel meant to be held unmounted in the hand, and the broad end designed for use, the obtuse end makes it convenient for handling, as the thumb of the right hand naturally rests on that edge." This celt is engraved at fig. 3 (one half actual size). The central figure of the illustration shows the convex face of the celt, the cutting-edge is at A, and the flat side at B; this cutting-edge is shown facing at C, and the flat side facing at D. The flat side of the flint chisel exhibits numerous highly lustrous spots or patches, which Mr. Smith

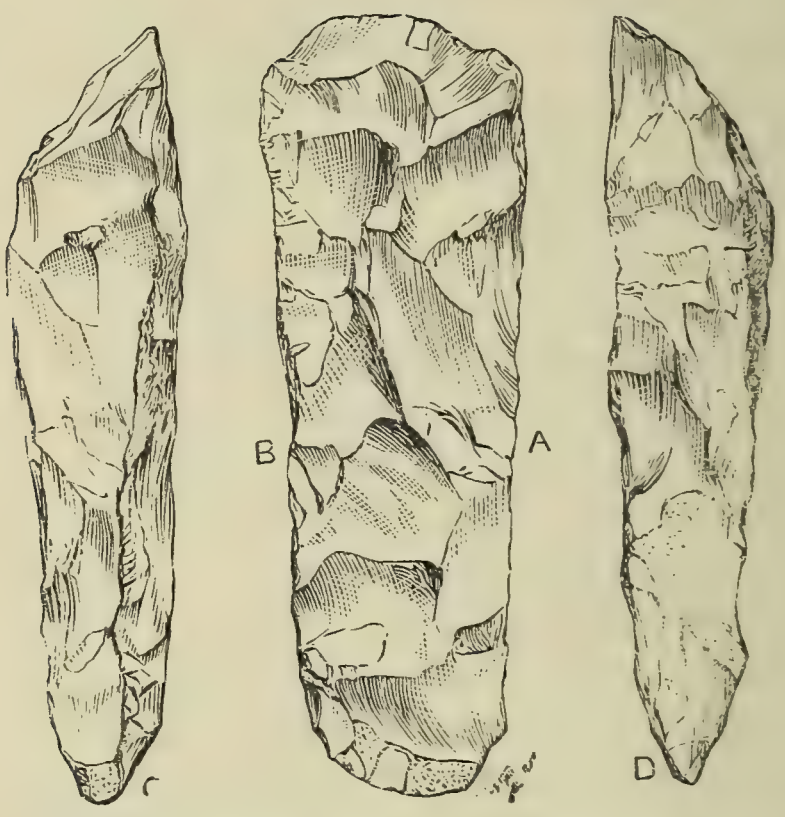


FIG. 3.—Celt found in Loughton Camp (one half actual size).

considers to have been caused by the attrition of minute grains of silex through a long series of years; this side was downwards in position in the rampart of the camp; the convex side was upwards, as is proved by the numerous ferruginous concretions which must have been deposited from above downwards.

No other implements were unearthed during the excavations, but this absence of finished tools is easily explained; the makers would naturally be somewhat careful of the results

of their labours, and implements were hardly likely to be found in the rampart; they could only get there by accident during its erection.

The number, position, and unweathered condition of the flakes seem to indicate that they were struck off at the time the camp was made, and that the makers of the structure used flint tools; but we put forward this suggestion with diffidence, as great caution is necessary in making deductions from the evidence at present in our possession, and we beg leave to refer to General Pitt-Rivers' separate opinion on this point given herewith.

Flakes, of course, are the waste splinters of flint struck off in the manufacture of tools, and were esteemed only as rubbish by the tool-makers. The question now is—Where are the finished tools which were produced by the flaking? Judging from what we know of other camps, and from the fact that a body of men, who perhaps used stone weapons and tools, probably lived inside the camp, it is not unreasonable to suppose that finished tools may be found within the space enclosed by the ramparts, if the original floor be exposed by the removal of a foot or two of the humus by which it is now covered. In this position, celts, arrow-heads, "scrapers," "knives," "fabricators," and other tools might be found, as we find them in the soil of other camps when the interior is disturbed by the plough.

Although none of the specimens appear to precisely agree in quality and texture with those found in Ambresbury Banks, still, as in that earthwork, the pottery of the Loughton Camp may be divided into two classes. The first is very coarse and of very rude manufacture, the clay being ill-prepared, and containing fragments of quartz and pebble; the other is thinner, of finer material, harder and closer in texture, and without the angular stony grains. Both classes are manifestly insufficiently fired, and all the specimens are *hand-made*. They have been submitted to Mr. A. W. Franks, F.R.S., of the British Museum, who points out the great difficulty of accurately estimating the age of rude pottery where no ornamentation is present to afford a clue, and where only

small fragments are available for determination. He is, however, disposed to rank the potsherds found as of *Late Celtic* age and manufacture. The pottery and flints have also been carefully examined by General Pitt-Rivers, who has written a Report upon them, which we give in his own words :—

"I regret much that the pressure of other business has prevented me, excepting on one occasion, from being present at the excavations at the Loughton Camp; but I have examined the specimens found in the cuttings, and very carefully preserved and ticketed by Mr. Cole.

"The pottery found in the first section on the old surface line, and in the body of the rampart, is of the coarse kind, with some large grains of some foreign material intermixed, which is commonly found in the ramparts of British camps. The pottery of the third and fourth cuttings is of a superior quality, without large grains, and apparently better baked; but the vessels had small irregular rims, and there is, I think, sufficient evidence upon them to show that they were hand-made, and not lathe-turned. Pottery of these two qualities not unfrequently occur together in British camps. There is no ornamentation to positively identify any of the fragments as *Late Celtic;* but, judging from the results of other excavations, I see no reason why they should not be of that period. I should certainly consider them pre-Roman.

"With respect to the flint flakes found in the body of the rampart and on the 'old surface line,' I do not consider the presence of flakes in these positions to afford positive proof that they were in use at the time of the construction of the camp. There are many spots on the surface of hills in which, if a rampart were to be thrown up now and explored at some future time, both the old surface line and the body of the rampart would be found to contain numerous flakes, the remains of earlier occupation by prehistoric man. I have also quite recently found the old surface line of the rampart thickly strewed with flakes, while other cuttings in the *same rampart* have shown evidence that the camp was of a more recent date than that in which the flint tools were used. The

comparative freshness of the flakes, however, although it may to some extent be attributed to the sandy nature of the soil, appears to me to favour the opinion that they were struck off and covered up soon after; and the finding of several fragments fitting one another confirms this view, as noticed by Mr. Worthington Smith. The discovery of a half-formed flint celt also appears to me to corroborate this opinion.

"On the whole, therefore, judging from the specimens Mr. Cole has been good enough to show me, I think the evidence is sufficient to identify the camp as pre-Roman, and probably of very early period."

In conclusion, we may be permitted to point out that the evidence brought forward in this Report agrees well with the theory of a British origin of the camp. Its irregular outlines, and the way in which the ramparts were adapted to the form of the hill on which it is placed, are characteristics of British methods of castramentation. The V-shaped section of the fosse is, as was pointed out by General Pitt-Rivers in his Report on the Ambresbury Banks, a very noteworthy feature, and a somewhat exceptional one, in British camps, so far as our knowledge extends; the ditches in the camps at Cissbury, Caburn, and Seaford were all flat-bottomed. The worn appearance of Loughton Camp, and the immense amount of denudation apparent in many places, favours the idea that it may be of earlier date than Ambresbury Banks, although both are of British workmanship. Whether their constructors used flint tools in ordinary life can only be satisfactorily determined by means of further explorations, both in the ramparts and within the enclosures. The numerous pits in the Loughton Camp, and the ground around the supposed "well," also deserve attention. The extended examination of these earthworks and the other prehistoric remains in the Forest is a matter not only of scientific importance, but also of very considerable popular interest to all inhabitants of London and its environs, who have now, thanks to the Corporation, a sort of personal lien upon its many attractions. No better or more permanently useful work can engage the energies of local scientific societies than an endeavour to gain and place

on record some definite and accurate information respecting such prehistoric antiquities as may still exist in their neighbourhoods; and we hope that the Essex Field Club may soon be placed in a position to continue the inquiry on the lines pointed out, which have already given such interesting results.

The Committee has great pleasure in thanking the Corporation of London for permission to explore the camp, and Mr. D'Oyley, the Hon. Surveyor to the Essex Field Club, Mr. R. L. Barnes, Mr. W. H. Bird, Mr. A. W. Franks, Capt. McKenzie, Mr. J. Spiller, Mr. C. Thomas, and Keeper Pearce, and others, for kind aid afforded during the progress of the work.

IX.

Notes on the London Clay and Bagshot Beds at "Oakhill Quarry," Epping Forest.

By N. F. Robarts, F.G.S.

[Read November 25th, 1882.]

The section exposed of the upper beds of the London Clay and Lower Bagshot at "Oakhill" Quarry and Brick-field on the south of the road running from Theydon Bois Railway Station to the "Wake Arms" public-house, and about one mile west of the station, has not, I believe, been yet described.

Before dwelling upon the few details of this section which I have to bring forward, I propose to give a short general description of the main geological features of the country lying between Hainault Forest and Waltham Cross. In doing this I must disclaim making any attempt at originality, my only purpose being to arouse some interest in our local Geology, and to induce others to study it for themselves.

The prevailing formation of both hills and valleys in this part of Essex is the London Clay, which has almost everywhere been extensively denuded, and in consequence of its great thickness forms not only the hills and slopes, but also the bottoms of the valleys, although the Clay is sometimes covered up and hidden by recent gravels and alluvium.

The valleys of the rivers Roding and Lea are good examples. Chigwell Row stands about 170 feet above the River Roding, and is formed almost entirely of London Clay, which rises to a still greater height at the Wake Arms and High Beach, whilst the eastern slope of the Lea Valley is similar to both slopes of the Roding Valley. The thickness of the London Clay in places where the Bagshot Beds overlie it—showing that in these places no denudation of the Clay has taken place since the Bagshot Beds were deposited—is about 300 to 400 feet. As a rule the upper beds of the Clay are wanting,

as they are only to be found where the capping of Bagshot Beds still covers them. Mr. Searles Wood is of opinion that the different ridges of Chigwell Row, High Beach, and Enfield have been raised by a force acting from the south-east, and that all the ridges dip more or less in that direction. If these ridges are ridges of elevation, the upper beds of the London Clay and the Bagshot Beds above them should dip in an easterly or south-easterly direction; but upon this I cannot at present give an opinion. The sections from wells in the neighbourhood are not sufficiently numerous or in the best positions to elucidate the difficulty. Most of the wells are in the valleys, and as these have all been extensively denuded, they form little or no guide to the original thickness of the

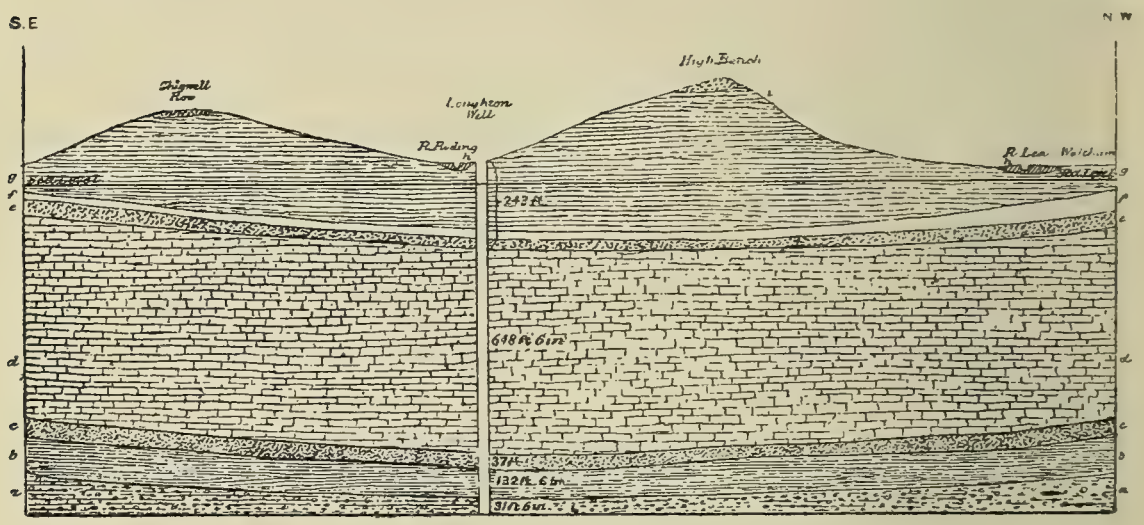


Fig. 1.—Section showing the strata in the district lying between Chigwell Row and Waltham.[1]

clay. I think there is an easterly dip in the "Oakhill Quarry," but the face of the quarry being to the east it is at present impossible to ascertain the angle at which the beds lie. In the brick-earth pits at Theydon Mount, which are also in the upper bed of the London Clay, there is a sharp dip to the south, so that Theydon Mount at all events consists of disturbed beds, and the probability is that the surrounding hills have been elevated in a similar manner. If, then, these ridges have been uplifted in the same general direction, we

[1] [The Club is indebted to Mr. Robarts for the three diagrams illustrating his paper.—Ed.]

shall have faults on the western side of each. There is no doubt that the western slopes have the same character with each other, in both cases being considerably steeper than the eastern ones.[2] Until the dip of the beds has been more accurately ascertained, fig. 1 will give an approximately correct idea of the strata in this part of Essex. The section is constructed from those given in vol. iv. of the 'Memoirs of the Geological Survey,' where sections are described at Hainault Forest, Loughton, Waltham, and Waltham Cross; and particularly from the section of a well dug a few years since at Loughton by the Great Eastern Railway Company, for the particulars of which I am indebted to Mr. Langley, Engineer to the Company, who has kindly furnished me with the same. Unfortunately, I learn from him that no fossils were obtained when digging this well, the only one, I believe, in this part of Essex which passed through the Chalk. The section is given in the diagram (fig. 1), and is as follows:—

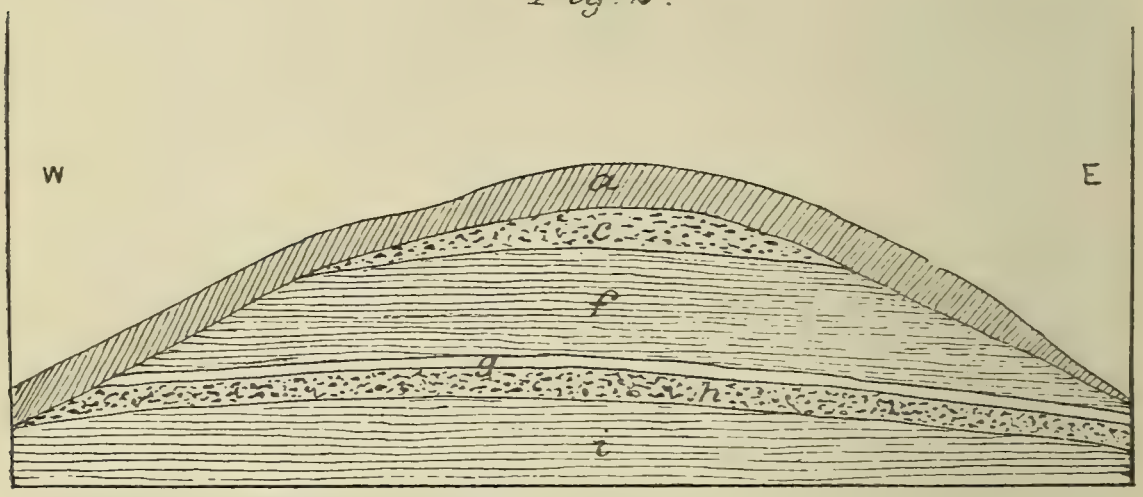
	Feet.
Depth to the Chalk	243
Chalk	648·6
Chalk and Upper Greensand . . .	37
Gault	132·6
Gault-Pebbles	31·6
	1092·6

The upper beds of the clay pass by almost imperceptible gradations from clay to sand into the Bagshot Sand, which is succeeded by the Bagshot Pebble-bed, consisting of flint pebbles. These beds, although once covering the whole area, are now only to be seen in sundry outliers at Brentwood, Havering, Theydon Mount, Oakhill, and High Beach. From the present slopes and valley-bottoms they have long since been denuded away. The principal difficulty about these beds, and that is rather a serious one, is to distinguish between the pebble-bed of the Bagshot and the later glacial gravels, or gravels of denudation, which are to a large extent composed of the re-sorted materials of the Bagshot Pebble-bed. These beds may be distinguished by their pebbles—the Bagshot Pebble-bed consists entirely of flint pebbles well

[2] I venture to throw out the suggestion that the greater steepness of the western slopes may be attributed, not to the faults, but to the greater denudation to which hills having that aspect have been exposed from the prevailing westerly and south-westerly winds and rain, which may have had considerable influence upon strata of such a character as the London Clay.

waterworn—the re-sorted pebble-beds and glacial gravels contain the Bagshot pebbles, with an admixture of angular flints, quartzites, and other travelled stones. These remarks will give a general idea of the relative position of the London Clay and Bagshot Beds; and premising that there is no very definite division between them, but that the clays gradually become more and more sandy until they reach the lower Bagshot Sand, which is described by Prestwich as consisting of light yellow, fine siliceous sand, and which is now usually recognised as the basement-bed of the Bagshots, and also mentioning that these beds invariably lie conformably upon the London Clay, I will describe the section at Oakhill Quarry.

Fig. 2.

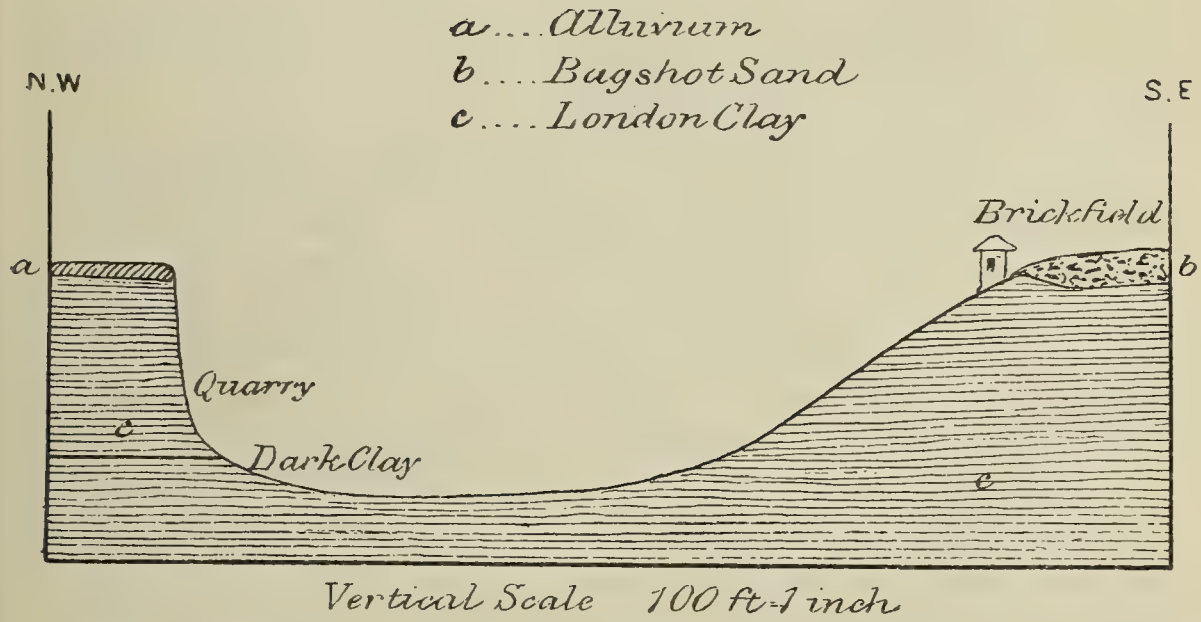


Section at Oakhill Quarry, Epping Forest.

The face of the quarry lies almost due east and west, and I have noted some six or seven distinct beds, but owing to the slips from the top and wash down the face, it is exceedingly difficult to see all the beds clearly at one time, although in dry weather most of them can be made out pretty easily. When I measured it last Easter the total depth of beds exposed was about 32 feet. The lowest (*i*, fig. 2) consists of sandy, dark, black clay, changing in some places to an olive-green; thickness 12 feet, probably considerably more, but the inferior bed was not exposed. At Brentwood this bed is exposed to the depth of about 20 feet. Upon its upper surface are found decayed septaria. Fossil remains are reported in this bed by the owner of the pits, but I have not seen or found any specimens, with the exception of a cast of shell enclosed in iron pyrites, which latter are found rather abundantly. The next in order (*h*) is a mottled grey, reddish, and fawn-coloured sandy clay, 3 feet in thickness, somewhat similar to the mottled clays of the Reading

Beds. In it is a band of sandy ironstone, and it also contains some black traces, probably lignite. Next is a band of sand (*g*), orange and white, containing traces of casts of organic remains, with ironstone concretions, the thickness only one or two inches. Above it is a mottled grey, reddish and fawn-coloured clay (*f*), slightly sandy, 12 feet in thickness, also with traces of lignite. Next comes a band of two or three inches of greenish sand (*e*), and then a band of greenish pipeclay (*d*) two inches thick. It is this band which throws out the water from the beds above. Above this is a reddish

Fig. 3



Section showing relative position of the Oakhill Quarry and Brickfield.

yellow clayey sand (*c*) 3 feet 6 inches thick, succeeded by 4 feet of sandy loam (*a*), with pebbles and subangular flints. This appears to be composed of wash from the beds above, and is derived from the Bagshot Beds, and probably contains some of the flints from the glacial gravels. These beds evidently very closely approached the Bagshot Sands, which have been denuded off them, unless the bed (*c*) be considered a remnant of them, which I incline to think is the case—the band (*d*) throwing out the water, and being the distinguishing line between the sands and the clays. The sands are, however, well exposed in the adjacent brickfield, a little to the west. Fig. 3 explains the relative position of the two sections. In it there still remains the capping of light yellow siliceous sand which has been denuded from the other beds exposed in the quarry. The clay beds underneath have not been worked in the brickfield. Adjacent to the sands, and a little to the

south-west, some remnants of pebble-beds remain,—the pebbles enclosed in a bright reddish sand,—a specimen of which is exhibited. These are probably remains of the pebble-beds. At Theydon Mount and Brentwood the beds are very similar. They are best exposed at the latter place, where they have been extensively worked. The Bagshot Beds in this part of Essex unfortunately appear to be entirely unfossiliferous. The sandy beds of the London Clay at Oakhill Quarry have some traces of organic remains, but I have not been fortunate enough to find any fossils. The upper part of the dark clay is said to contain sharks' teeth and shells, but I have seen none. I have mentioned septaria being found there, and these are also constant at Theydon Mount and Brentwood;[3] and from Theydon Mount I exhibit two sharks' teeth, lent me by W. Bonner, of the brickfield there, ¼ mile north of Hill Hall.

In conclusion, the section at Oakhill illustrates the great denudation which has taken place in the river-valleys of this neighbourhood; it shows the conformity of the beds of the London Clay and Bagshot Sands, the latter strata being evidently of the same formation as the Clays, revealing the history of the beds, the deposition of which commenced in a deep sea during a period of depression, and continued possibly during a period of elevation. It shows, at all events, after the deposition in deep water, a gradual shallowing until the shore deposits, becoming more and more sandy, at last ended in pure sand and pebbles; and these patches of sand and pebbles on the highest grounds show the greatly extended area formerly covered by the Bagshot Beds, of which these isolated outliers once formed part. The dip of the beds has yet to be ascertained, and when this is found there still remains to be verified Mr. Searles Wood's statement that there are faults on the western sides of the hills. Until this is accurately decided the actual thickness of the London Clay at High Beach cannot be given; it may be nearer 600 than 400 feet, but if so, it is exceptionally thick. The denuding power of aqueous and atmospheric agencies over a soft stratum like the London Clay is well illustrated by the section, as well as to the amount of elevation which took place subsequent to the deposition of the Clay. In conclusion, I must thank one of our members, Mr. E. Heathfield, for assisting me in measuring and examining the beds at the quarry.

[3] The specimen of septaria exhibited from Brentwood was remarkable for its nucleus.

JOURNAL OF PROCEEDINGS

AT

ORDINARY, FIELD, AND OTHER MEETINGS.

Saturday, February 25th, 1882.—Ordinary Meeting.

The twenty-fifth Ordinary Meeting was held at the head-quarters at seven o'clock, the President in the chair.

Donations of books, pamphlets, or periodicals (exclusive of "exchanges" with other scientific societies) were announced from Mr. R. L. Barnes (2 journals monthly), Lady Brady, Mr. C. Darwin, Mr. Andrew Johnston (2 vols.), Mr. A. Lockyer, Sir John Lubbock, Miss E. A. Ormerod, Mr. W. White, and Mr. A. P. Wire. Mr. G. C. Harcourt presented to the museum the first portion of a collection of the flowering plants of the Forest district (preserved with their natural colours and forms by Mr. English), consisting of 127 species, and the six cases containing the same. Mr. C. Oldham presented a number of bones and horn-cores of a species of *Bos* found in digging a trench in a yard in Maybank Road, near George Lane Station, Woodford, concerning the age of which some doubt was expressed. Mr. Saward presented a number of skins of Essex birds (12 species), and stuffed specimens of six species; also a stuffed specimen of the common weasel. Miss Spicer, stuffed specimens of the jay and missel thrush, from Woodford.

Cordial votes of thanks were passed to the donors, special attention being directed to Mr. Harcourt's interesting and valuable present.

The following persons were elected members of the Club:—Messrs. T. C. Baring, M.P., D.L., &c., Chalkley Gould, J. H. Gurney (Jun.), F.Z.S., W. H. Harwood, Henry Laver, M.R.C.S., F.L.S., Walter Mawer, F.G.S., D. J. Morgan, and A. P. Wire.

The President said—We have to record the death of one of our members, Mr. George Thomas Saul, who died on the 22nd January, at the age of 69. Although never personally with us, he took great interest in the work we are doing, and helped our fund for the investigation of the Ancient Camps. He was a Fellow of the Zoological, Royal Botanical, Horticultural, and other Societies, and took great interest in the introduction and propagation of new plants. Large-hearted and of warm

sympathies he was in a quiet way always ready to help where help in any form was needful; and to a large circle of private friends his death is the subject of deep regret.

Owing to pressure of business, an error occurred in the conduct of the Annual General Meeting, in consequence of which this Meeting was made Special, for the purpose of formally proposing the additions to and alterations in the Rules of which notice had been given at the Meeting on December 17th [see 'Proceedings' ii. lxxxi.], and for the election of two Honorary Members.

As Honorary Members the Council proposed Professor John Morris, M.A., F.G.S. (an eminent geologist, and a gentleman who had taken great interest in the Club), and Mr. W. Saville Kent, F.L.S., F.Z.S., F.R.M.S., author of the 'Manual of the Infusoria.'

Both these gentlemen were unanimously elected.

The Secretary then proposed, on behalf of the Council, the Additions to the Rules above referred to, which were unanimously confirmed.

The Meeting proceeded to discuss the question of the protection of birds and animals, and the preservation of the natural features of the Forest. A full report of the discussion is given in Appendix No. 1, issued with this Part of the 'Transactions.'

The usual conversazione concluded the meeting.

Saturday, March 25th, 1882.—Ordinary Meeting.

The twenty-sixth Ordinary Meeting was held at the head-quarters at seven o'clock, the President in the chair.

Donations for the library were announced from Mr. B. G. Cole (2 vols.), Mr. W. Cole (22 vols. and sundry pamphlets), Dr. M. C. Cooke (9 vols.), Mr. W. H. Dalton, Mr. H. G. Fordham, Mr. Andrew Johnston (26 vols.), Mr. A. Lockyer (2 vols.), Prof. Morris, Mr. Oldham, Dr. Pearce, and the Tyneside Naturalists' Field Club (7 vols.) Special votes of thanks were passed for these valuable donations.

The following were elected members of the Club:—Messrs. J. Whiteley Brown, W. W. Brown, Lieut. Croft, R.N., F.L.S., F.R.M.S., George Day, Miss E. S. Powell, Messrs. A. W. Shrewsbury and H. M. Wilkinson.

Letters of thanks for election as Honorary Members were read from Prof. Morris and Mr. Saville Kent.

The Secretary announced that progress had been made in the preparation of the memorial in favour of the preservation of wild animals, and the retention of the natural features of Epping Forest. Statements had been received from Prof. Boulger and Dr. Cooke, and one was promised by Mr. Harting. Resolutions in favour of the movement, and letters of sympathy had been received from many societies and naturalists. [See Appendix No. 1.]

Mr. Letchford, F.R.M.S., as one of the race of "pond-grubbers," said he would be glad if the Society succeeded in stopping the system of deep-drainage, but he was afraid the Conservators would say that they considered the Forest as a recreation-ground for the inhabitants of the eastern parts of London.

The President thought that the position taken up by the Club repre sented the best interests of the inhabitants of London. He could not see the justice of giving the Forest over to the "inhabitants of Eastern London," if by that phrase was meant the public-house frequenters. There was quite room enough for all without in any degree spoiling the Forest for the lover of Nature. He hoped they would be able to get together such a large number of protests, and from such representative bodies and individuals, as would convince the Conservators that there was a large section of the public interested in the Forest from a purely Natural History standpoint, and the feelings and wishes of such persons deserved quite as much consideration as the supposed wishes of the unintelligent and unreflecting public-house supporters. [Applause.]

Mr. A. P. Wire read the following :—

"Note on the Woolwich Beds at Leyton, Essex.

"In excavating recently for the new deep sewer in Union Lane, Leyton-stone, the men cut across a bed of dark-coloured mud or clay, which the most cursory examination showed to be full of fragments of shells. The bed had evidently never before been disturbed by the hand of man, and questions arose as to the position of this stratum in the geological system, its name and origin, and the history of the broken fossils. The London Basin is so well known to geologists that it was unlikely to be a new discovery, although it might be such as far as the exact locality was concerned.

"The mud is very loose, of a dark colour, and even if dried readily disintegrates when put into water. Small masses more or less indurated were occasionally found, but its looseness gave great trouble to the workmen by its continual subsidence and consequent sinking and breaking of the drain-pipes.

"Careful washing of the mud on a fine sieve under a gentle current of water revealed the fact that scarcely a whole shell could be found, and that the fragmentary fossils were more numerous than anticipated. By far the larger quantity of these are *Cyrena cordata* in all stages of growth, from the tiny young, scarcely larger than a pin's-head, to the full-grown adult an inch and a quarter across. This shell is a bivalve, but very rarely were both valves found together or united. In one or two specimens found whole, the animal mass had been transformed into a hard black substance interspersed with spangles of native bisulphide of iron (iron pyrites). Among the washings were found species of the genera *Planorbis*, *Hydrobia*, *Valvata*, and some others. All these are fresh-water shells. Among the finer washings the microscope did not reveal any remains of smaller organised forms. The mud, when treated with nitric acid and boiled, left a residue of fine sand. As far as observation goes no pebbles larger than, or as large as, a pea exist in the mud, but a piece of wood was found attached to a mass of broken *Cyrenas*. In endeavouring to identify the stratum, and find its place in the geological system, a consideration of the locality and its surroundings solved the difficulty.

The bed has from 12 to 17 ft. of gravel lying over it, and was undoubtedly deposited in the estuary of a river ; over this has accumulated the London Clay, but the River Lea, flowing on through countless years, has worn away the London Clay, firstly exposing these beds known as the 'Woolwich series,' and then piled on them the accumulation of river gravel that lies there. Here, then, we have beds, lying not far from the surface, that originally lay beneath the London Clay, and for some distance along the Lea Valley it is well known that the London Clay is very thin, or is gone altogether.

"Mr. E. T. Newton, of H.M. Geological Survey, kindly named the fossils and identified the stratum for me.

"Objects placed in the museum of the Club to illustrate the above note :—

"1. Semi-indurated mass of mud containing *Cyrenas*.
2. Specimens of *Cyrena cordata*.
3. Washings from the mud.
4. Micro slides (2) containing smaller fossils, simply mounted as opaque objects for preservation."

Mr. N. F. Robarts remarked that it was satisfactory to learn that the strata referred to by the author had been authoritatively identified, since, so far as he was aware, there was no known exposure of the Woolwich and Reading beds in that part of Essex. He referred also to the author having spoken of the Woolwich beds as fresh-water deposits, whereas he believed they were marine and estuarine. He congratulated Mr. Wire on having made an addition to the knowledge of these beds by discovering the remains of a shell hitherto unknown to palæontologists as coming from these strata. It was an example of the really useful work which the members of the Club might do.

Mr. Wire replied that Mr. Newton could not at first believe that the shells actually came from a stratum at Leyton, but on sending him specimens of the mud itself, he (Mr. Newton) had determined it to be of the Woolwich series.

Prof. Boulger had very little doubt from what he had seen of the specimens that the stratum described by the author was a portion of the Woolwich series, but he would like Mr. Wire to ascertain the horizon, as it was very important to know in what part of the Woolwich series it was situated.

The President said he might remind their geological members that in the Ordnance Survey maps a patch of the Woolwich and Reading beds is laid down at Stratford and West Ham, and another between Wennington and Stifford.

Mr. English exhibited a young female specimen of the Scaup Duck (*Fuligula marila*, Linn.) shot on October 15th, 1881, by Mr. W. Ainger, as it was flying up from a pond about half a mile from Epping, in the parish of Theydon Garnon, being the first recorded appearance of the bird in the Forest district. The day previous had been very boisterous and stormy, and no doubt the duck had been driven inland by the gale. The

Scaup Duck is a winter visitor to this country and rather a late one, seldom making its appearance until the end of October or beginning of November. In the estuaries and along the flat shores it is met with plentifully, often in very large flocks; but it rarely betakes itself to inland fresh-water. Its food consists of mollusca, small fish, aquatic insects, and marine plants, which it obtains by diving.

Mr. W. Crouch exhibited a specimen of the Shoveller (*Anas clypeata*, Linn.) shot by Mr. Llewellyn Hatton, on the 27th October, 1881, at the River Roding, near St. Swithin's Farm, Barking Side. Mr. Hatton stated that he had never seen one there before during forty years of shooting. About the date mentioned there was a week or so of intensely bitter weather, and the bird had doubtless come with the wild ducks (then in abundance) for feeding, or had been driven inland by stress of weather. Mr. Crouch thought that the Shoveller was almost unknown in this part of Essex, but it was occasionally met with as a spring and autumn migrant in the eastern portions of the county and in Suffolk, probably coming from Belgium. In Norfolk it sometimes remained to breed.

Mr. Charles B. Sworder exhibited some pieces of pottery and bones found by Mr. J. Brown during operations for the draining of land belonging to the Sutton Estate of the Charter House, at Little Hallingbury, Essex. The ground in which they were found was stiff clay, overlaid with a flinty soil, but where the pottery and bones were found it was dark, and in places there was a considerable quantity of charcoal with stones showing the effects of fire. At some little distance there was blue clay, from which Mr. Sworder thought the vessels might have been made. "They vary in make, some being globular, others the shape of a flower-pot, and from 3 to 18 inches in diameter. Some about 1-8th inch, others nearly 1 inch thick, all with rims varying in design; some with marks made in turning, others with a rough design upon them; the material also varies considerably, and a few bear traces of colouring, black, red and blue. They were found at depths varying from 18 to 30 inches from the surface, and the dark soil is in bands from 2 to 15 feet wide, the ditches intersecting them."

Remarks upon the specimens were made by Mr. Robarts, Rev. W. Linton Wilson, and Mr. Sworder, and, at the suggestion of the President, Mr. Sworder left the pottery in the Secretary's hands for examination by some competent authority.

The Secretary called attention to an old encampment called "Wallbury," situated about a mile from the field in which Mr. Sworder's specimens were found, as being likely to prove of interest to the Club. Mr. Archer Houblon, the owner of the land on which it is situated, had replied to inquiries as follows:—"The Camp at Wallbury is an undoubted one, but whether it was held by Britons against Romans, or by Romans against Britons, I can give you no information; I have always been desirous of obtaining some. The situation is very interesting, and the form of the work is very perfect, denoting that the camp was constructed with great

care. I should be very glad if some scientific gentlemen would go over the ground and examine it thoroughly, for I think it extremely probable that highly interesting discoveries might be made." *

Mr. R. M. Christy sent up for exhibition some specimens of the true "Bardfield oxlip" (*Primula elatior*, Jacq.) from Pounce Hall Wood Saffron Walden, and also some specimens of the form which is commonly mistaken for the Bardfield oxlip, but which Mr. Christy considered to be a hybrid between the common primrose and the cowslip.

[Prof. Boulger entered into some very interesting details respecting these specimens, but, as Mr. Christy is preparing an exhaustive paper on the Essex forms of *Primula*, it will be best to reserve any remarks until after the publication of that essay.—Ed.]

The Secretary read two notes by Mr. John Gibbs, of Chelmsford. The first treated of those inflorescences that are definite, but in which the order of expansion is not strictly centrifugal :—

"In the report of your country ramble on the 1st of August last, I find that the teasels were noticed as illustrating the artificial nature of the classification of inflorescences into centrifugal and centripetal, from which I think it likely that some interest will attach to the appended list of genera in which I have observed inflorescences that are unquestionably definite (that is, having a central flower terminating the floral axis), but the order of expansion is not strictly centrifugal :—*Clematis*, *Caltha*, *Aquilegia*, *Acer*, *Dianthus*, *Rubus*, *Pyrus*, *Cornus*, *Viburnum*, *Sambucus*, *Campanula*, *Syringa*, *Ligustrum*, *Medinella*, *Mercurialis*, *Luzula*.

"Owing to the limited nature of the sphere of my observations the list is not long, but, including as it does representatives of several Natural Orders, it may be very much extended. The exotic genus *Medinella* I have only seen once in a conservatory, where its flowers might have been affected by changed conditions."

The second note treated of the inflorescence of *Vinca*, and of the seedlings of *Ranunculus ficaria* :—

"On several occasions within the last twenty years I have attempted to call the attention of botanists to the inflorescence of *Vinca minor*, which is commonly supposed to be indefinite, but which I have no hesitation in describing as *definite* and *centrifugal* like that of *Stellaria media*, or some species of *Silene;* only that the leaves are more fully developed on the subterminal branch, which, springing from the axil of one of the uppermost leaves below the flower, is prolonged beyond it so as to throw the flower on the other side, and make it seem axillary. In ordinary cases the only indication of this character is found in the strictly unilateral

* From Morant's 'History and Antiquities of Essex' we take the following:—"The Maner of Wallbury. This place was so named from its situation on the old Roman vallum, *i. e.*, fortification, or camp, which terminates in a precipice above the Stort. It comprehends about 30 acres, double ditched, very little defaced. The precipice on the north has some additional work on the brow of the hill; the other three sides seem to be in their original state. One side of the ditch is on the meadow opposite to Sawbridgworth. 'Tis well nigh a mile in circumference, not four square, but rather sexangular." Vol. ii. 514. See also Gough's 'Camden,' ii. 63, and Wright's 'History of Essex,' ii. 323-4.—Ed.

position of the flower as contrasted with that of the Pimpernel, in which a pair of flowers appear in the axils of a pair of leaves. Sometimes it happens, as in one of the specimens I send you, that the uppermost pair of leaves is divided by an internode which becomes a peduncle opposite a leaf, and bearing a small leaf immediately below the flower, or it may be blended with the calyx. If the peduncle of the vine be truly terminal, so is this ; and I venture respectfully to invite the attention of Essex botanists to it."

Prof. Boulger remarked that Essex was very fortunate in possessing so careful, accurate, and painstaking an observer as Mr. Gibbs. He referred to a small work by Mr. Gibbs, a copy of which was in the Club's library —'A First Catechism of Botany'—as an admirable little book; it was not only very amusing, but was full of sound information, and based largely on personal observation.

"The History of Botanical Investigation in Essex" — by Professor G. S. Boulger, F.L.S., F.G.S., Part. I.—Gerarde, Parkinson, Dale, and others to the time of Ray, was then read by the author.

In proposing a cordial vote of thanks for the paper, the President observed that Prof. Boulger had gone into the records of the county of Essex so fully, and had devoted so much time to the subject, that they could hardly be too grateful to him. [Applause]. The facts which he had brought forward went to show that the county was most intimately connected with the rise and progress of British Botany, and he was sure all the members would look forward with great interest to the future portions of the paper.

Votes of thanks to the authors of the various papers read were carried by acclamation.

The usual conversazione followed, at which Mr. C. B. Sworder, Mr. Oldham, and Mr. English exhibited specimens.

Saturday, April 1st, 1882.—A Visit to South Kensington.

On this Saturday afternoon the Club varied its usual programme, and the members, instead of travelling into the wilds of Essex, or losing themselves in the leafy recesses of Epping Forest, journeyed to South Kensington, and met at three o'clock in the magnificent Central Hall of the New Natural History Museum, Cromwell Road. The meeting was held on the invitation of Prof. Richard Owen, C.B., F.R.S., who had very kindly offered to conduct the Club over the recently re-arranged geological collections. The party numbered considerably over 100, and included many of the better-known members of the Society. Admiration was freely expressed by those who for the first time had an opportunity of viewing this really noble temple of science. English people are seldom self-laudatory when speaking of their National Scientific Institutions,

and are, perhaps, even too ready to admit that they do such things better in France or Germany, but Mr. Waterhouse's building may worthily take its place beside the greatest architectural triumphs where the object kept in view was to combine the useful and the beautiful—the greatest amount of well-lighted space with true artistic proportions and adornments. When the various galleries and rooms are filled with the unique series of specimens now hidden at Bloomsbury, the new Natural History Museum will be, as Professor Owen very justly remarked, absolutely unrivalled in the civilised world. Precisely at the time appointed the Professor met the party, and he was, of course, greeted with the respectful applause due to one of the great veterans of modern biological science. After a few words of welcome, and some preliminary observations on the general plan of the building, he led the way into the Palæontological Gallery, and commenced an eloquent and pleasant exposition of some of the more striking and scientifically valuable specimens contained in that chamber of Nature's *bizarre* workmanship. Of necessity it would be impossible to reproduce even the substance of Prof. Owen's discourses; they were essentially object lessons—delightfully chatty, learned, and discursive. By reason of the large numbers attending the meeting, many who crowded round the venerable Professor were unable to follow fully what was said, but the brightened eye and animated smile of the narrator as he stood beside some of his more cherished specimens spoke of a living enthusiasm unabated by long familiarity with his subject or oft repetition of details. This was especially noticeable as he described some huge fossil tusks of *Elephas ganesa* found in a sandstone quarry in the Upper Miocene deposits of the Siwâlik Hills, in India. The animal which bore them, he showed, must have sunk into the soft sand of some delta, where it would have lain while the surface of the globe was going down, down, and more sand was deposited and other strata were formed above it, so remaining through ages, until the gradual upheaval of the earth which followed forced the surrounding sand into the ivory at such enormous pressure as to convert that substance into stone—a process which, from the nature of things, he explained, must have taken place before the formation of the Himalayan Mountains. An officer of engineers (Captain Cautley) superintending blasting operations for cutting a canal through the rock, noticed a piece with two round "bullseyes" embedded, and set aside this and other pieces similarly marked. Shipped to England and shot down like rubbish in the great square before their museum at Russell Street, the marks proved to be sections of these tusks, which piece by piece were cut out from the sandstone and mounted complete. Professor Owen endeavoured to give life and meaning to the dry bones of high antiquity which are ranged in the galleries in such bewildering variety—to the imperishable remains of the massive *Deinotherium*, the *Mastodon*, and the still more wonderful *Megatherium*, the gigantic land sloth of the late Pliocene, and more particularly the Post-Pliocene, formations of the New World. The survey of the remains of this last-named colossal beast, with its massive hind-quarter

bones, fitted for the attachment of muscles still more powerful, evoked an interesting exposition of the chain of reasoning which enables comparative anatomists to mentally reclothe the skeletons of extinct animals with the vesture of life, and to speak with confidence not only of their general habits, but even sometimes of special incidents in their biographies. This great sloth was formed with tail and hind legs to sit tripod-like before a tree, and powerful enough, so sitting, to pull trees down. The shape of the skull and jaws showed that the tongue was long, cylindrical, powerful, and muscular, fitted like that of the giraffe for plucking down boughs; and the size of the aperture for the nerves which induced motion in the tongue led him to say that this organ in the *Megatherium* was four times the size of the tongue of the giraffe in the Zoological Gardens. One specimen found must have been twice stunned by some falling mass which had fractured the skull, and the animal probably died from inflammation which set in when the second wound was partly healed. The wounds were so severe that the animal receiving them must have lain helpless for some time; therefore they were not likely to have been given by a foe, such as the lion of the period, who would certainly have killed a prostrate victim. The wounds were received at long intervals apart, and the assumption was that on two occasions in its life the animal had pulled trees down upon itself, the second accident causing a lingering and painful death. Later on, in the Reptilia galleries, came demonstrations of the great marine reptiles, the *Plesiosaurus*, with its 22 feet of length, and *Ichthyosauria* with large eyes and terrible jaws, from the Lias; nor were the Professor's especial favourites forgotten,—his "Dragons" or *Pterodactyles*,—great volent lizards, some with flying-membranes, or wings, expanding 20 feet, which ages ago may have rendered "night hideous" as they glided in search of prey through the moonlit air of the primæval world.

The party had also the benefit of the presence and assistance of the genial Keeper of Geology, Dr. Henry Woodward, F.R.S., who did all in his power to render the meeting a success, and who demonstrated to a section of the party the late Sir Antonio Brady's collection of Pleistocene Mammalia from Ilford, Essex, now in the Museum; and Professor Morris, who was present, also rendered valuable help in like expositions.

A cordial vote of thanks was passed to Professor Owen on the motion of the Rev. W. Linton Wilson, and the Club then adjourned to the Exhibition Galleries, South Kensington Museum, where General Pitt-Rivers, F.R.S., conducted the party over his Anthropological collection. This collection is probably unique of its kind. It is a museum of primitive arts, arranged in accordance with the modern views of evolution. It exhibits, by means of selected specimens, the development from rude beginnings of certain arts and handicrafts, such as tools, weapons, pottery, musical instruments, clothing, weaving, horse-furniture, agricultural implements, personal ornaments, ship-building, ornamentation, &c. The General accompanied his guests through a large portion of his museum, stopping before each case to give short impromptu lectures, in which

he detailed the teachings of each series of objects in a most interesting and instructive manner. Particularly happy was his exposition of the development of a pattern upon a series of paddles. Commencing with a rude representation of a human face, the gradual conventionalisation of the primitive idea was clearly traceable, until at length nothing was left of the face but the *nose*, so altered and degraded as a mere ornament that nothing short of positive demonstration of the successive stages could make the student believe that the apparently meaningless figure was indeed a remnant of a savage face.

The whole collection is one of great extent and completeness, and it is greatly to be regretted that mere red-tapeism should be allowed to interfere with its retention as one of the national collections in accordance with General Pitt-Rivers' munificent and patriotic offer.

At the conclusion of a most instructive demonstration, which lasted until almost dusk, the General was warmly thanked by his audience on the proposal of the President. A general stampede took place to the refreshment department, and the remainder of the evening was spent in strolling through the picture galleries until the dial warned the visitors that it was time to bring a most delightful and instructive meeting to an end. The Secretary cannot close this short record of the proceedings without personally acknowledging the kind and ready assistance afforded in the arrangement of the meeting by G. Wallis, Esq., F.S.A., the Resident Keeper of the Art Collections, South Kensington Museum.

Saturday, April 22nd, 1882.—Field Meeting.

The members of the Club were called together at Theydon Bois Station for a forest ramble. The very heavy rain during the morning had the effect of reducing the numbers, so that not more than a score took part in what proved to be a very enjoyable meeting. The party included the President, Prof. Boulger, Mr. N. F. Robarts, F.G.S., Mr. Andrew Johnston, Mr. John Spiller, F.C.S., Dr. Cory, &c. Starting from Theydon Bois at a little after 3 o'clock, the gravel-pits on the north side of the forest road over "Oak-hill" were soon reached, and a discussion ensued as to the origin of the gravels and ferruginous sands there exposed, which were believed to be of the Bagshot formation. Crossing the road into the brick-field, further lighter-coloured sands were seen exposed to the depth of 8 or 10 feet, and from thence the members made their way to the "Quarry" in Oak-hill Enclosure, where the clays are now worked for the tile-kilns. The Superintendent of the works informed the party that shells and sharks' teeth were occasionally found in the lowest part, in a bed of dark slate-coloured sandy clay. The section, which exposes about 80 feet of stratified clays, was much obscured by recent rain-wash and falls, but some of the beds were clearly defined, and in the bottom

slate-coloured bed, decomposed Septaria were found. An animated debate was raised as to whether the clays belonged to the basement beds of the Lower Bagshot or the upper beds of the London Clay, together with their relation to the sands previously seen on the other side of the brook.* Going through the Oak-hill Enclosure, where the rhododendrons, planted many years ago, have produced an abundance of seedlings, a route was taken through "Hang-boy" Slade to Great and Little Monk Woods, many questions of geological and botanical interest being started during the ramble, and a final halt was made at the "Wake Arms," where tea was served. At its conclusion the President, after a few words relating to this being the first Field Meeting of the year, referred to the recent death of Mr. Charles Darwin. He said:—Our own Club and British science in general has sustained a very heavy loss—in fact the heaviest loss which British science could possibly have sustained—by the death of our honorary member, Charles Darwin; and this being the first meeting held since that calamity, I think it only just to allude to it in a few words. I shall have somewhat more to say about the noble life of that illustrious naturalist when we meet next Saturday. In the meantime I just pay this small tribute of respect to the memory of a man who was certainly England's greatest thinker, the man who has stamped this age with a line of thought which will run through all future ages. I think I am perfectly justified in mentioning the circumstance now, because Mr. Darwin himself took always the very liveliest interest in our proceedings, and I have many letters from him at home in which he congratulates me on the success which seemed to be attending our Field Club.

Mr. Andrew Johnston said it was very gratifying to remember that the very first thing which occurred to him as Treasurer was to receive a cheque from Mr. Darwin for the Forest Camps Exploration Fund (1882).

Starting again, a pleasant walk through the Forest, turning aside by

* Mr. N. F. Robarts, F.G.S., to whom the Editor is indebted for the above geological sketch, has given the results of his investigations at Oak-hill Quarry in a short paper which will appear in a future part of the 'Transactions.' In passing it may be well to call the attention of well-wishers of the Forest to the fact that Oak-hill Enclosure is *private property*, and is now put up *for sale*. We understand that negotiations have from time to time been attempted to acquire it for the Forest, but some details as to cost have prevented the Conservators from buying it hitherto, although they are fully impressed with its importance. Anyone who will glance at the map, or better, will visit a very delightful spot, will recognise the *immense* importance to the public of this piece of 10 or 12 acres. To build over it would utterly destroy the natural repose of the pretty Theydon Woods, and we most ardently hope that means may be found by which this nook could be retained for the Forest, of which it is naturally an integral portion. Surely, if the Corporation of the City of London does not see its way to buy the land, it would only be a graceful thing in a few of the many thousands who have benefited by its noble efforts in the cause of open spaces to *subscribe* the comparatively small sum demanded, and present "Oak-hill Enclosure" as a good-will offering to the Conservators for the benefit of the public, and so save the Forest from a well-nigh irreparable injury and loss. *Verbum sat sapienti.*—Ed.

the way to view the Loughton Camp, on the history of which the excavations to be speedily undertaken by the Club will probably throw some light, took the whole party to Loughton Station.

SATURDAY, APRIL 29TH, 1882.—ORDINARY MEETING.

The twenty-seventh Ordinary Meeting of the Club was held at the headquarters at seven o'clock, the President in the chair.

Donations to the library were announced from the President, Mr. Harting (2 vols.), Mr. Mawer and Mr. Fisher Unwin (14 vols.) Mr. R. M. Christy sent for presentation a bust of John Ray, and a small collection of about 50 specimens of birds' eggs, mostly from Essex. Mr. Wire presented a specimen of the curious shell-marl from Copford, Essex. Unanimous votes of thanks for these presentations were passed.

The following were elected members of the Club :—Rev. N. Brady, M.A., Edward S. Hasell, Hugh H. Mason, Rev. Brian S. Waud.

The President then rose and said :—Since our March meeting we have had the misfortune to lose by death an honorary member whose works have for nearly half a century been guiding lights to naturalists and philosophers throughout the whole civilised world. When in future years we look back to the period of the foundation of this Society, we shall point with pride to the name of Charles Darwin as having been among those of our earliest supporters. This great philosophical naturalist breathed his last on Wednesday, April 19th, at his quiet home at Down, in Kent, in the 73rd year of his age. The wealth of thought and the vast accumulation of facts that he has bequeathed to posterity can be realised only by those who are familiar with his writings, but the influence which he has exerted upon biological science during his lifetime amounts to no less than a revolution. Unlike many great reformers in the world of science, he lived to see the results of his patient and exhaustive inquiries into Nature's inmost processes accepted by the leading minds of the age; he bore with philosophic calmness the revilings of bigotry and the narrow-minded rancour of mistaken theologies for the sake of the great truths which Nature had revealed to him. This gentle-hearted and noble-minded Kentish squire has earned for our country and for our age a reputation which will extend far into futurity, and the historians of science will henceforth refer to this as the Darwinian epoch. The great doctrine of Evolution has now become part and parcel of all our scientific ideas, and the theory of development, built on a biological basis by Darwin, is permeating all branches of science and philosophy. I do not now propose to dwell at any length upon his labours; he has too recently been removed from our ranks, and I hope on some future occasion to be able to give you some account of them. His mortal remains justly repose among England's greatest, and he was followed to

his last resting-place in Westminster Abbey, on Wednesday, April 26th, by a procession representing all ranks of society, every grade of political and religious opinion, and every branch of human learning. The gap caused by the loss of this illustrious leader is one not likely to be soon filled up, and wherever human culture extends there has been homage paid to his memory. Many of the rising naturalists of the present day owe their first tastes to the writings of Darwin, and much of the work that has been done by the younger men of the time has been prompted by his ever ready sympathy and kindly encouragement. The vivacity and earnestness of his manner when in conversation can never be forgotten by those whose privilege it was to know him personally; the kindliness of his disposition and the greatness of his nature will cause him to live in the hearts and minds of all who ever came in contact with him. It is with the greatest satisfaction in our own case that I am able to state that he always took a great interest in our prosperity. While every scientific body both here and abroad mourns the loss that has befallen it we must not omit to pay our small tribute of respect to the memory of Charles Darwin, who honoured us by having his name enrolled upon our first list of honorary members. I am sure that I am expressing the will of this Society in moving that the Secretary, on our behalf, should forward a letter expressing to Mrs. Darwin and the family our sincere sympathy and condolence for the irreparable loss which they and the country generally have sustained.

Mr. Worthington Smith said:—I should like to second that proposal with your permission. I think I need not say a single word more than Mr. Meldola has done, which was only a fitting tribute to his memory. Mr. Darwin was an occasional correspondent of mine, and of course I, together with all scientific men, held him in the greatest possible admiration.

The vote was at once agreed to unanimously.

The Secretary exhibited, on behalf of Mr. Charles Wilson, a very fine specimen of a "fasciated" daisy, from Mersea Island, Essex. The specimen appeared to consist of three flowers conjoined. He also exhibited, on behalf of Mr. Gibbs, a seedling of the Pilewort (*Ranunculus ficaria*), concerning which Mr. Gibbs wrote as follows (under date 21st March):—

"Having read in a magazine that *Ranunculus ficaria* did not reproduce itself from seed, I found last June some ripe achenes of this plant by the side of a ditch where it grows abundantly. I sowed them, and have now half-a-dozen seedling plants of *R. ficaria*, in which the cotyledons are laterally coherent, so as to make the young plant look like a seedling of *Sinapis* or *Brassica*, of which one of the cotyledons had been destroyed."

Mr. Gibbs also sent a "List of native plants found in the neighbourhood of Chelmsford" ['Proceedings' ii. l. *note*] which is reserved for the present; and the following note on the characters of the inflorescence in the genus *Acer*:—

"Three species of *Acer* are now (28th April) in bloom in this neighbourhood:—*A. platanoides*, *A. pseudo-platanus*, and what I take to be a rather precocious variety of *A. campestre*. In *A. platanoides* and *A. campestre* the inflorescence is definite, and in its order of expansion corymbose as distinguished from centrifugal. In *A. pseudo-platanus* it seems to be formed on the same type, but a raceme of lateral flowers is developed on the central peduncle above the branches, which branch again. The central axis is normally terminated by a flower, which, however, is occasionally abortive, and only the lateral flowers of the raceme give origin to fruits, the others dropping. These particulars I have observed myself, but do not remember to have read of them."

The Secretary stated that nearly all the species in Mr. Gibbs' list had previously been recorded in Gibson's 'Flora of Essex,' but the President remarked that it was nevertheless always interesting to have a confirmation of the recorded species by a competent observer.

The Secretary announced that he had received a paper "On the Protection of Wild Animals and Birds" from Mr. Harting to be appended to the proposed memorial, to which he was receiving signatures almost daily. He also stated that he was much grieved to notice the previous day that deep drainage had commenced on Wanstead Flats, near Whipps Cross, and that many ponds valuable to the microscopist and general naturalist were being destroyed. After considerable discussion of the subject, Mr. Cole moved that a deputation from the Society should be empowered to confer with the Verderers on the matter, and that in the meantime a letter should be sent to them calling attention to the changes being made in the Forest, and asking them to use their influence to check the same until at least the public had expressed its opinion. This proposal was seconded by Mr. Hutchinson, and carried unanimously.

Mr. N. F. Robarts exhibited a flint "flake" with four "facets," found by himself in the brick-field at "Woodredon Hill," Epping Forest, about a foot below the surface, having been probably ploughed in from above or buried by worms. He also exhibited, on behalf of Mr. Daw, a flint celt, of which the following description has been kindly written by Mr. Worthington Smith. Mr. Daw has generously presented the Club with the accompanying woodcut, drawn and engraved by Mr. Smith:—

Chipped Celt found at Enfield.

The flint celt, chisel, or gouge here illustrated was found by a workman at Bycullah Park Estate, Enfield, in surface-soil from beneath the roots of a tree. The instrument is now in the possession of George H. Daw, Esq. It is $4\frac{3}{8}$ in. long, $2\frac{1}{8}$ in. wide at its broadest part, and weighs a little more than three ounces. It is made from a large flake of pale liver-coloured flint, none of the original crust of the stone being exhibited. A considerable part of the plain surface of the original flake—the side on which the bulb of percussion once was—is very distinct on the concave side. The instrument was originally chipped all over with great neatness and precision, and the broad cutting edge at length carefully ground on both sides. There is little or no trace of grinding or polishing at the smaller end.

This implement is an unusually beautiful, symmetrical, and well-made example of a somewhat uncommon form. It is far too light and delicate to have been used as a hatchet, axe, or adze, and it may quite possibly have never been intended for mounting in a wooden handle at all. It is probably a stone chisel, and was designed for hand use; its form is such

Fig. 1.—Chipped and partly polished celt found at Enfield.

that it can be readily grasped in the hand, as one holds the wooden handle of a chisel or gouge. It is remarkable not only for its extremely neat and beautiful workmanship, but for the geometrical precision of its form and its incurved sides, the belly of the implement being less in width than its smaller end. The broad cutting edge shows but little evidence of use.

In Dr. John Evans' 'Ancient Stone Implements of Great Britain,' p. 67,

two instruments of this class are figured, one being larger and the other smaller than the Enfield example; neither, however, exactly resembles in form the specimen here illustrated.

Instruments of this class were doubtless used for light domestic work, for the manufacture of neat things in wood and bone, for skinning dead animals, and probably also for removing the flesh from the bones.

It is difficult to quote an age for an instrument of this class. Stone was used for the manufacture of weapons and tools prior to the discovery of bronze and iron. The Bronze Age was passing or had passed away at the time of the Roman Conquest, and iron was coming into use. It is, however, certain that in places where metals were only procurable with difficulty stone remained in use for axes, adzes, knives, &c., long after the knowledge of bronze and iron was spread over Britain. Judging from its lightness, beauty, and precision of make, the Enfield celt or chisel probably belongs to a more recent period of the Neolithic Age. Some of these very neat tools were probably made and used by women and girls.

Mr. Worthington Smith then read a paper entitled "Primæval Man in the Valley of the Lea" [see 'Transactions.'] The paper was illustrated with diagrams and specimens, the result of Mr. Smith's long-continued attention to the subject; the specimens in most cases were found by himself, some *in situ*.

The President said they had all listened—and no one more than himself—with the very greatest interest to this paper, for Mr. Worthington Smith spoke with the authority of an investigator who had personally examined their river-gravels for many years; and any one who had had the privilege of seeing his splendid collection of implements must know what a large amount of time and thought he had given to the subject. By his habit of labelling every specimen, and taking notes of the precise conditions under which each had been found, he had rendered a great service to the archæological part of anthropology; and they knew that all observers were agreed in giving to Mr. Smith the credit of being the most active and successful finder of these weapons in the London district. Mr. Smith had found weapons and tools of three distinct types; he would like to ask whether there was any advancement of skill displayed in the three successive periods. He also desired to know whether Mr. Smith recognised the view put forward by Mr. Alfred Tylor, who introduced what he called the Pluvial Period immediately after the Glacial Period, and if so whether this would not take off something from the date of the river valleys by indicating that the rate of excavation was considerably more rapid then than at present. Those who were familiar with the speculations of Mr. Croll on the Glacial Period knew it was deduced from astronomical calculations that the necessary combination of events to bring about the last Glacial Period—for there had been several of them—occurred about two hundred and forty thousand years ago. If that calculation were correct, and if Mr. Croll's speculation were admitted, it seemed to fix some kind of date for Palæolithic man, for they knew for certain that man was post-glacial, and there was some evidence to show that he was possibly pre-glacial in this country; he referred to Mr. Skertchley's

find.* And finally he wished to know whether Mr. Smith had noticed any relationship showing a sequence in time of the river-gravels when compared with the glacial gravels in their district.

Mr. Robarts said he felt sure he spoke the feelings of every member in saying how much they were obliged to Mr. Smith for his admirable paper, which had given them a great deal of information about what had occurred in their own neighbourhood. He should like to ask one or two questions with regard to the hammer-stones. He wished to know whether Mr. Smith had found these to be made of many kinds of stones, or whether they were chiefly of quartzite—whether he had been able to trace that one particular stone was better adapted for making implements than another. Also, with regard to the three ages to which Mr. Smith had referred, and the smaller and more finished implements which were made in the latter period, whether the size of the implements was any indication of the date—whether the very largest implements were all of the very oldest date, or whether any of the very large implements were found in the latest age ; in fact, whether the gravel contained such large stones at the latest dates as it did at the earlier dates. Mr. Robarts also alluded to the perfection of form shown in some of the Neolithic celts, and expressed an opinion that they were really finer than some of the best axes we had now; that was to say, the curves were more beautiful, though the implements were not perhaps so well adapted for cutting.

Mr. Smith, in replying, placed implements of the three ages side by side, and held that they furnished conclusive evidence of a marked improvement in the manufacture, and therefore in the status of the men who made them. He was not able to give an immediate and short answer to Mr. Meldola's question as to the rate of denudation of river valleys ; the subject was a large and intricate one, and a whole evening would hardly suffice for its discussion. He next referred to the question raised by reference to Mr. Skertchley's discovery, and said he had unfortunately seen none of Mr. Skertchley's sections, and so could give no opinion from his own observation. Opinions were very much divided as to the age of the material in which Mr. Skertchley had found the so-termed glacial implements. Mr. Smith had found implements in gravel said to be middle-glacial at Amwell, Ware, and Hertford, but some geologists questioned the age of these deposits. The "hammer-stones" were nearly always of *quartzite;* he had only two examples made of another stone: both were of flint ; one a rudely cylindrical nodule, the other a fossil cast from the Upper Chalk—an Echinite (*Ananchytes ovatus*) ;—this had been "found" by a palæolithic man and used as a hammer-stone, and a flake detached by repeated hammering. As to the sizes, he was sorry to say that size was not an invariable test of the age of an implement,

* See Prof. Ramsay's 'Physical Geology and Geography of Great Britain,' pp. 481 and 544; Prof. Boyd Dawkins' 'Early Man in Britain,' p. 169, note (1880); 'The Fenland, past and present,' by S. H. Miller and Sydney B. J. Skertchley, p. 546 (1878); and Proc. Essex Field Club, vol. ii., p. xxiv.—Ed.

although the older ones were generally large, and the more recent examples small.

A cordial vote of thanks was passed to the author for his valuable paper and exhibits, and the usual conversazione followed.

SATURDAY, MAY 6TH, 1882.

On the afternoon of this day Her Most Gracious Majesty the Queen visited Epping Forest in state, and at the appointed place on the brow of High Beach Hill declared the Forest free and open for ever. The President and Secretary were invited by the Corporation to the ceremony to represent the Essex Field Club.

SATURDAY, MAY 13TH, 1882.—LECTURE AT THE BRITISH MUSEUM.

Dr. Henry Woodward, F.R.S., F.G.S. (Keeper of Geology), some little time ago promised to give a special lecture on "The Ancient Fauna of Essex" to the Club, at the British Museum (Natural History), South Kensington. Originally it was fixed for May 6th, but Her Majesty, having selected that date for the formal dedication of Epping Forest to the public, Dr. Woodward consented to postpone his lecture for a week, and it was accordingly delivered at 3.30 o'clock on this day in the Private Lecture Theatre. The substance of the lecture is embodied in Dr. Woodward's paper in the 'Transactions' published herewith, and a report was given in the 'Essex Times' for May 19th, 1882, from the excellent shorthand notes of our member, Mr. George T. Reid. The lecture was illustrated by a copious exhibition of specimens, maps, and diagrams, many of the latter having been specially prepared for the occasion by a member of Dr. Woodward's family, and the comfort of the members and visitors was attended to in every way by the officials of the Museum.

Professor Morris said there had been some discussion as to the real age of the beds containing these remains of Mammalia. At one time it was thought that they were of two distinct ages—the Crayford and the Grays beds of one age, and the Ilford beds of another age, and that they represented to some extent an interglacial period, but from considerations which he named it appeared that these beds containing the remains of Mammalia were properly posterior to the glacial period. At least that was his own opinion on the subject. After some further remarks on the geology of the district, Professor Morris concluded by moving a vote of thanks to Dr. Woodward, and expressing his belief that they must all go away delighted with the knowledge they had obtained of the fauna of the Thames Valley, so interesting to the members of the Essex Field Club.

The President, in seconding this, took occasion to express a hope that the Conservators would not pursue a line of action which would remind one of that attributed by Dr. Woodward to the beavers. He assured the lecturer that, as far as the Essex Field Club had any influence with respect to the management of Epping Forest, every effort would be made to urge upon the Conservators the necessity of keeping the woodland in its natural condition. Mr. Meldola, in conclusion, stated that the magnificent collection of Essex fossils which they had on a former occasion inspected in the galleries of that Museum under the guidance of Professor Owen, bore witness to the richness of the river-drift deposits in their own neighbourhood, and were lasting monuments of the zeal and energy of their late respected member, Sir Antonio Brady. It was by no means to be supposed that work on the Essex shore of the Thames had been exhausted; much as Sir Antonio had done, this was to be regarded as but an incentive to further effort, and no Society was in a better position to extend these investigations than their own Club.

The vote of thanks was passed by acclamation, and Dr. Woodward afterwards conducted the party through the Palæontological Galleries, and practically demonstrated many of the more remarkable forms alluded to in his lecture.

Saturday, May 20th, 1882.—Ordinary Meeting.

The twenty-eighth Ordinary Meeting was held at the head-quarters at seven o'clock, the President in the chair.

Contributions to the library (exclusive of "exchanges" with various societies) were announced from Mr. R. M. Christy and Mr. Andrew Johnston (2 vols.), and thanks voted to the donors.

The following were elected members of the Club:—Messrs. A. E. Balleine, G. P. Hope, H. R. Leach, Herbert Livermore, and W. H. Wright.

Mr. R. M. Christy sent for exhibition and presentation to the Museum the nest of a bee found inside that of a bird, probably a chaffinch. It was found about the end of July, 1878, by his brother, lying in a meadow close to the house. "The bee had worked up the hair and feathers forming the lining level with the top of the nest, and had then bored three holes down into it, at the bottom of one of which several larvæ or pupæ were noticed." *

* The insect which formed the nest was probably *Bombus pratorum*, L., generally a common species, the nests being frequently found in hay-fields, on mossy banks, and under furze bushes. It is one of the humble-bees commonly called "moss-builders" or "carder-bees," from the notion that they card or comb the moss which they use in the construction of their nests. The late Mr. Fredk. Smith gave, in his 'Catalogue of British Hymenoptera' (Part i., 2nd Edition, 1876), the following interesting particulars of their habits, which we quote as illustrating Mr. Christy's exhibit:—"Several instances have come to my knowledge of the sagacity of these insects in making use of the nests of birds, and of their adapting them to their own requirements. . . . . Dr. Bell

Lieut.-Col. Russell, J.P., D.L. (of Stubbers), read the following paper on—

"Martins and Sparrows.

"Although of late years we have heard much of the destruction of birds, and of the efforts made to protect them, yet the steady progressive disappearance of one of our best species, the house martin, appears to escape general notice. According to Gilbert White, of Selborne, there was hardly a town or village in his time that did not swarm with martins. My own observations, extending over nearly half a century, lead me to think that there is scarcely one martin now for fifty formerly. The cause of this decrease is plain enough to any one who keeps his eyes open—the sparrows turn the martins out of nearly every nest they build. In villages once frequented by perhaps 500 martins, now only three or four nests can be seen, all, or nearly so, occupied by sparrows, which may be seen going in or out, or sitting a few feet off, watching the martins build till the shell is advanced enough to suit them; or, again, an untidy bunch of grass or straw hanging out shows what has taken place. When the martins, for protection from their 'fell enemies,' as White rightly called the sparrows, make their nest close to a window or door, it is generally destroyed by people who seem to have no notion that, except in a place where the sparrows are afraid to come, the martins have scarcely a chance of keeping a nest. I have heard it said 'they must do it for mischief—they might build anywhere else.' I could give any number of instances of martins being finally banished by the sparrows from houses and buildings where for many years they have bred in ever decreasing numbers. Plenty of such cases occur every season, and they cannot re-establish themselves without help. In some favourite places they build a nest or two every year, but are always turned out by the sparrows. The only thing which prevents or retards the total extermination of martins in this country is that, after building nests all the summer and being robbed of them, they sometimes succeed in rearing a very late brood after the sparrows have all left off nesting and betaken themselves to the wheat fields. When thus detained the martins often suffer much from cold weather before their young can fly, and a frosty night in October will destroy many, old as well as young.

observed the nest of a robin built in the porch of his cottage at Putney; some time afterwards he found that a humble-bee had taken possession of it, and had adapted it to its own purposes. Unfortunately the nest was destroyed before he had ascertained the name of the species; but, judging from the description Dr. Bell gave of the bee, there can be little doubt of its being *B. pratorum*. Mr. Walcott, of Bristol, communicated a similar account of finding the nest of a robin invaded by *B. derhamellus*, the eggs of the bird being covered with the accumulation of pollen and honey stored up by the bees. Mr. Walcott added to this account:—'I have in two previous instances found broods of the same bee in birds' nests.' Another correspondent gave me the following account of *B. muscorum*:—'This insect took possession of a wren's nest at Holmbush, near Brighton; I had observed the bird building, and afterwards was astonished on finding that a bee had taken possession of the nest, and had, as I found, constructed its waxen cells amongst the eggs of the wren.' A very remarkable account of one of the brown bees was related to me by a lady, who observed it frequently flying into a stable through a latticed window; the bee was engaged in collecting a bundle of horse-hair from a heap accumulated from currying the horses. Having made up a small parcel, the bee flew off with it a short distance, and settled down with it among some grass. On examining the spot a nest constructed entirely of horse-hair was discovered. This very interesting nest was unfortunately destroyed before the bee had quite completed its construction."—Ed.

"Numbers of people who would think it most barbarous to shoot martins, yet let the sparrows persecute them without hindrance; and this in the long run has exactly the same effect as constantly shooting them. The sight of this persecution, which I cannot help seeing in passing through any village where a pair or two of martins still survive, gives me the same feeling towards sparrows that I should have towards rats if I saw them carrying off young chickens; and I cannot understand how any one who takes interest in birds can fail to see the persecution, or to feel otherwise about it. Around my house and buildings the martins, formerly abundant, were reduced in numbers, till in 1869 young ones flew from only two nests, one close to a door, the other to a window. Towards the end of May, 1870, several nests just built under the eaves of a pigeon-house had all been taken by sparrows. The indignation with which I had seen this practice all my life at last boiled over. It seemed hard that the martins should have no place to live in unmolested, so I resolved to give them one, and began to protect them by killing the sparrows. War has been waged against them ever since; I pay 1d. for shooting every sparrow, as soon as it comes, all the year round. The result has been that in the successive years beginning with 1870, we have had 7, 20, 45, 51, 68, 81, 100, and 110 martins' nests. They now seem to have reached the number that can get a living there; for the last four years the numbers have varied a little, but have not been below about 130 nests. Similar results might be produced almost anywhere. The martins, unlike many other birds which must go before building, cultivation, and drainage, would, if they could keep possession of their nests, increase with the population of the country. So much has been written in praise of sparrows, very much to the detriment of the martins, and taken for granted by people who do not observe for themselves, that many will ask 'To protect your martins, do you not destroy equally useful birds?' Even were the sparrows equally useful, the martins are as much pleasanter to look at as squirrels are than rats. I would not take £10 a year for my martins, and therefore would not tolerate the sparrows if they did me good to that amount; but I cannot find that I lose anything by their absence.

"Martins are perhaps the most desirable of all birds to have about a house; being perfectly harmless we cannot have too many of them; living entirely on insects they are most useful. As for preferring sparrows to martins because the latter are here only six months in the year, to me it seems like preferring, as I have just said, rats to squirrels, were there a similar reason. But there is, as the proverb says, no disputing about tastes; I wish to call the attention of those who prefer the martins to this subject. The fact is, that these birds have become so scarce as to be almost unknown or unthought of by nearly everybody; or, now that so many take interest in birds, the martins could hardly fail to find plenty of friends. I wish that all the admirers of sparrows could see my martins, that they might know how much they lose by their favourites; if they were not induced to kill the sparrows, they would at least, I think, not allow the nests of the martins to be poked down and destroyed when they build them close to their windows for protection, with a confidence in man too often misplaced.

"The question whether sparrows are useful to the farmer is easily decided; they never go far from houses and roads into the fields except at certain times of the year, for the sole purpose of eating the corn, as may be proved by examining the contents of their crops. If they did any good to the farmer at all, the land near their haunts would be worth more to cultivate than the enormously greater extent of ground where they never take an insect. But this is not the case; the well-known ravages they commit on the grain, especially when it begins to form in the ear, are the

only noticeable effects produced by sparrows near villages, houses, and roads. Sparrows also do much mischief in gardens—by feeding off young peas, lettuces, &c., eating green peas from the pods, stripping gooseberry bushes of their fruit buds, and destroying crocus flowers. The question remains whether they do good enough in gardens to make up for such misdeeds there. For some years I carefully investigated the question of sparrows' food, examining that taken out of thousands, old and young, killed at all sorts of times and places. The general result was that the old ones contained little else but corn, rarely an insect. The young are fed with a great variety of food—corn, green and ripe, green peas, insects, &c. At least 95 per cent. of a sparrow's food during its whole life seems to be corn.

"To prove that sparrows are really useful, it is not enough to show that they destroy some insects; it must also be shown that in their absence other birds would not destroy them as effectively. My object in letting no sparrows live anywhere near my house has been partly to get a better practical test of their utility than any amount of examination of the food in their crops. Sparrows having been almost entirely absent from my place for years, if they took insects which other birds will not, such insects would increase, and the sparrows killed there would show this. Now it has been quite as unusual to find an insect in an old sparrow there as elsewhere. In fifty of all ages, from the time they first feed themselves, killed there one summer with food in their crops, this consisted of corn, milky, green, and ripe, and sometimes green peas; only two small insects were found in the whole number. The old ones, however, eating few insects anywhere, this was not test enough, but if any insects were the peculiar prey of sparrows, and had increased, any nestlings there should be full of them. A pair or two of sparrows have therefore generally been allowed to have a nest in or near my garden, and nearly every year young ones have been taken there and the food in them carefully examined with a lens. It varied greatly, but certainly there were not more insects, if as many, as where sparrows abound. Of caterpillars, supposed to be kept down by sparrows, only two small ones, and those in callow birds, have been found during the twelve years. On the whole, the deduction from these tests, so far as they go, seems to be be that the insects given to their young by the sparrows, were they allowed to live in numbers about my premises, would be so much food taken when they most want it from better birds which live entirely, or nearly so, on insects, and thus, where not displaced by those 'parasites on civilisation,' the sparrows, keep down the insects much more effectively than the latter. After the absence of sparrows for twelve years, everything in my garden seems to do as well as elsewhere; and many things better. For instance, the young peas want no protection beyond trapping the mice; except one year, when the titmice took it into their heads to eat them; the green peas are not taken from the pods, and, unless bullfinches come and live in the garden in winter, the gooseberry buds are not picked out, consequently we have had extraordinary crops of that fruit for some years past.

"The general results of my tests seem to prove at least that no one need fear that he does any harm if he shoots every sparrow which goes near a martin's nest. Whether it would be easier to protect the martins by killing such sparrows only, or all those about the premises, I cannot say; but the former plan can easily be tried by those who, for any reason, do not wish to kill more sparrows than is necessary.

"About my house are plenty of swallows; that they are not displaced by the great numbers of martins shows that the two birds live on different food, and that we want both to keep down different insects. As martins, in all places where they can keep their nests, are at least twice as

numerous as swallows, the food of the former must be more abundant. I think the swallows take larger insects than martins. In the part of the country where I live, when we had plenty of martins, the midges which bite so badly were unknown; as the martins disappeared, the country became full of the midges. I rather think that these things were cause and effect, for when we had hardly any martins the midges would not let us sit in the garden on still, warm evenings from April to October, and since the martins have so much increased there my garden is comparatively free from these pests, while in all other gardens near they are as bad as ever. The martins are worth all the other birds put together, in showing life in the air for six months in the year in town, village, and country, always to be seen about the houses when protected. They are individually less graceful in their flight than swallows, but their greater numbers when they have fair play, their habit of nesting and flying in company, and generally higher, and their bright black and pure white plumage, make them a better feature in the view. I should be very sorry to be without either swallows or martins. To any lover of birds, accustomed to see them in numbers, a place looks dull in summer without martins, and their disappearance seems to me an evil of national importance, only to be avoided by protecting them. Some people would gladly destroy the sparrows, but fear that shooting them would banish other birds. There is no ground for this fear. Birds have quite sense enough to disregard noise which does not hurt them. About my house other birds not being shot take no notice of the report of a gun, and when a sparrow is shot near their nests the martins really seem to enjoy the sight, and often come hovering round in a crowd where their enemy has just fallen. Among the birds which nest in and close to my garden are rooks, jackdaws, starlings, ring-doves, stock-doves, turtle-doves, missel-thrushes, blackbirds, thrushes, and nightingales, besides numbers of small birds of most of the common species. Swallows and martins are often in dry weather put to great straits for want of mud with which to build their nests. For the last two or three years I have supplied them with clay, and find that the best way is as soon as the birds come to put the clay in a heap near a pond, and once in a few days throughout the summer to spread a very little of the clay with a spade a few yards along the edge of the water, so as to wet it. Both species use it freely. If much is put into the water, pigs, if they can get at it, will soon remove the clay by wallowing in it."

[Mr. J. E. Harting, F.L.S., has favoured the Editor with the following remarks:—"I have read Col. Russell's paper on 'Martins and Sparrows.' He seems to have made out a good case against the sparrow, in his own neighbourhood at all events. But it does not follow because he has found on examination of the contents of stomachs that the sparrow feeds chiefly on grain, ripe or unripe, in his district, that this is its food *everywhere*. The sparrow, like other creatures, adapts itself to circumstances, and in towns, where it cannot procure grain, it lives on a great variety of food, and destroys a great number of insects, aphides of various kinds, and cockchafers.

"I think if I were in Col. Russell's place I should do as he has done, but I should not go so far as to advocate a universal slaughter of sparrows."—Ed.]

The President said they were very much indebted to Col. Russell for this interesting paper, which was evidently the result of many years' personal observation and experience. The author had certainly brought a very serious list of charges against their old and lively friend, the sparrow.

Mr. Andrew Johnston said he did not think they had a martin's nest left in the country side, except a few which were inhabited by sparrows, and this was occasioned, he supposed, by the thickness of the population encouraging the sparrows. He wished to ask Col. Russell two questions. One was whether, if they could destroy the sparrows sufficiently, the martins would come back, after having lost the habit of being there? And he was told that martins' nests were inhabited by *bugs*. Had Col. Russell's 130 martins' nests produced a corresponding appearance of that objectionable insect inside his house?

Col. Russell had no doubt the martins would come back, and that in ten years' time the place would be full of them. He knew that martins were commonly said to bring bugs, but he did not believe it. He had never traced any connection between the bed-bug and the martin; in fact, he thought that the bird's nest-parasite was a different species.

Mr. W. Cole said that the parasite of the martins' nests was a true *Cimex*, but was not the same species as the bed-bug (*C. lectularius* L.). It had been described by Jenyns as *Cimex hirundinis*, and is somewhat smaller, narrower, and more hairy than the common species. He believed it had never been found within houses. The bugs infesting bats and pigeons were likewise considered to be distinct forms by some entomologists, and had been described under the names of *Cimex pipistrelli* and *C. columbarius*.*

Mr. Letchford said that though Col. Russell had brought a long list of charges against the sparrows, he did not think it any too long. Accounts from South Australia showed that the importation of sparrows by that colony had been very disastrous; they had taken the whole crop of grapes. They had not heard Col. Russell charge the sparrows with taking our fruit, but he believed it was one of the indictments which might be brought against them.

Col. Russell said that Mr. Letchford was perfectly right. In America, Australia, and New Zealand sparrows had been introduced, and the people did not like them at all. But he had heard of other birds—greenfinches in New Zealand, for instance—that when sent abroad they not only practised all the wickednesses they committed here, but developed fresh ones. Sparrows seldom destroy fruit in this country; he had never seen them do so himself, but he had heard from others that they sometimes attack cherries and green currants, pulling off and dropping a good many. Most of the sparrows in this country would be got rid of if all could be induced to crush their oats, for the number of any birds depended on the amount of food at the worst time, such as the middle of winter.

Mr. Rees said it was quite true that the sparrows had done a great deal of harm in Australia; he had received a letter a short time ago from

* Specimens of *C. lectularius* and *C. hirundinis* were exhibited, as well as the curious dipteron, *Stenopteryx hirundinis* of Leach, which also infests the martin.—Ed.

his brother, who wrote that the sparrows had cleared a field; and he was quite certain that in England too the sparrows did a great deal of harm.

The President: The general concensus of opinion seems to be that we should deal rather roughly with the sparrow, but I should very much like to hear some gentleman say a word or two in his favour, if he can. Because if this discussion goes out to the world without any adverse comment, the sparrows no doubt will have a bad time of it. Mr. English, have you anything to say in defence of the sparrows?

Mr. English was afraid he could not speak much in favour of them; being fond of horticulture, he found them a great torment to the peas. He went on to say that it was strange how easily they were deceived; he had lately observed sparrows very busily gathering the petals of the apple-blossom, and he found that they used the petals to line their nests; it was clear that they had mistaken them for *feathers*.

The Secretary read the following letter from Sir Clarke Jervoise, Bart., dated Horndean, Hampshire, May 17th :—

"I see by the card which arrived this morning that on Saturday next the subject of 'Martins and Sparrows' will be discussed. It may be of interest if I narrate my own experiences.

"Some years ago there appeared in the 'Times' a letter from the Rev. F. O. Morris, of Nunburnholme, near York, on the subject of martins being in possession of the 'coignes of vantage' at his house. Next year the sparrows were in possession. The third year neither martins nor sparrows inhabited the locality. This fact I believe I was able to explain thus :—One year some martins built over my front door and reared their brood. Then the sparrows took possession of the martins' dwelling, enlarged the front opening, and furnished the nest according to their taste with the various materials they are in the habit of using, *horse-hair* among the rest. The second year, as I was dressing in a room (on Sunday morning) opposite, I heard a great deal of screaming, and saw the martins flying about evidently in great trouble of mind. One of the martins in coming from his house had put his head through a noose which he had made out of the horse-hair at his own front door in attempting to restore the style of building which had been altered by the sparrows. I got a short ladder, and liberated the martin. The next year the martins declined to build for the sparrows, and there were, therefore, no martins and no sparrows.

"I now observe that the same little game is begun by the sparrows in a martin's nest of last year. I shall give the sparrows notice to quit, and I feel confident the martins will then return. They can afford to wait, as the present weather in this very dry county does not admit of building material for martins' nests being readily found."

The Secretary went on to say that he was quite dismayed at the severity of the charges brought against the sparrows. It must be remembered, however, that the hawks, the natural checks upon the undue increase of the Passerinæ, had been in great measure exterminated by the irrational, unprofitable, and selfish systems of game-preserving now practised, and not until keepers were deprived of their *guns* could we hope to see the admirable balance of Nature restored. To aid, artificially

and unduly, the increase of purely insectivorous birds might eventually inflict quite as much injury upon the gardener and farmer as was popularly supposed to be done by the sparrows. Insects did work of immense importance in the fertilization of flowers and removal of noxious matter. If man would only cease to "meddle" ignorantly with Nature, less "muddle" and failure would likely be the portion of the modern husbandman. He read a letter received from their member, Mr. F. C. Gould, who was unavoidably prevented from personally doing battle for the sparrow. Mr. Gould wrote:—

"I hope the little fellows will find plenty of supporters, for I certainly don't like the idea of killing them off in order to save a few martins from the annoyance of having their nests taken. I have never noticed that sparrows molest martins either while building or in their nests, but only that the sparrows will sometimes take possession of an empty nest before the martins return in the spring. I noticed that a month or two ago. Two lazy sparrows took possession of a martin's nest at the back of my house, and proceeded to convert it to their own use by enlarging the aperture, and they eventually made the hole so big that the nest tumbled down. It is, of course, possible that the martins who occupied the nest last spring would have used it again this year, but I don't suppose that the particular pair of birds will, in the absence of their old home, give up the idea of house-keeping. They will simply build a nest elsewhere, and, although I am sorry to lose them, some one else will get the benefit. Therefore it seems to me, unless it can be proved that the sparrows interfere so much with the martins as to diminish their numbers, the case against them breaks down, and they don't deserve the wholesale slaughter apparently advocated by some.

"The sparrow is such a bright, merry, albeit pugnacious little chap, and makes himself so much at home with us all the year round, that it is not fair to turn on and discard him in favour of birds which only stay with us as long as the weather suits them. Some people profess to think that sparrows have no beauty, but let anyone paint or model one, and he will find out his mistake."

Col. Russell, in reply to this, said that, as one instance among a great number within his own knowledge, there was a cottage close to his place where sparrows were taking some martins' nests. He asked the man if he liked the sparrows. "No," he said; "I hate 'em, and am always throwing stones at them, but cannot keep them from the martins' nests." Thereupon Col. Russell lent him a gun, and the man's little boy taking kindly to it—[laughter]—cleared out the sparrows. The martins came and increased until the cottager had 24 nests. That man died, and the new tenant did not protect the martins. In *one year* the sparrows drove them all away. Sparrows sometimes pull small young martins out of their nests and throw them down. A man once saw this done near Col. Russell's house; he got a ladder and put the martins back. In ten minutes the sparrows had pulled them out again! He only knew of one exception to the rule that sparrows drove martins away, and that was at Thorndon Hall, Brentwood, Essex, Lord Petre's place that was burnt down a few years back. He was told that the place

was a paradise for martins, but the absence of sparrows was to be accounted for by the absence of their food, as Thorndon was not used, the gardens were not kept up, and there were no cornfields there.

A cordial vote of thanks was passed to Col. Russell for his paper.

The Secretary then read a paper entitled "The Lepidoptera of the District around Maldon, Essex; a contribution to the insect fauna of the county." By Gilbert H. Raynor, M.A., Vice-President of the Cambridge Entomological Society. [See 'Transactions.']

In connection with Mr. Raynor's essay, the Secretary read the following interesting letter from our member, Mr. W. H. Harwood, of Colchester, the well-known collector. Mr. Harwood wrote:—

"I have never been to Maldon, and, beyond spending a day at Danbury, have done no collecting in what I call the Maldon district. Tiptree Heath is, I think, a little nearer Maldon than Colchester, but the few excursions I have made there have been very profitless. I have collected a good deal in the woods at Messing and Layer Marney, about midway between Colchester and Maldon, but they are probably beyond Mr. Raynor's limits. I find them very productive as regards certain species, but the number of species that occur in them is very small as compared with the woods between Colchester and Ipswich and those in the Tendring Hundred. I have never seen *Argynnis adippe* at Messing, or *Limenitis sibylla*; *A. paphia* is very rare indeed, and I do not remember to have seen either *A. euphrosyne*, *A. selene*, or *Melitæa athalia*.

"The food plants of *L. sibylla* and *M. athalia* are in abundance, but though the woods are full of flowers I have not noticed the dog-violet, but it must surely be present.

"Probably *L. sibylla* has occurred, and has been exterminated by birds. I have bred very many specimens, and never found the larvæ 'ichneumoned,' nor do I think birds meddle with them in the larval state; but they probably destroy a large proportion of the pupæ in some localities. In some of my best hunting-grounds there is fortunately no game-preserving, and consequently the small birds are fewer in number than when the predatory species are more systematically killed off.

"*Limenitis sibylla* is only found when the 'slop' or underwood is high, and a considerable clearance in a small wood means sometimes the all but total extermination of the species in that particular wood, but colonists from neighbouring woods soon restore the balance, so soon as the favourable conditions again obtain, but when there is no neighbouring wood the balance may never be restored.

"In very hot seasons local butterflies become to some extent *migratory*; such was the case with *L. sibylla* last July, and I should not be surprised if this year specimens are met with in woods where none have been previously seen. Mr. Laver saw a specimen in the town here last year two miles from any known locality."

After a few remarks by the President and Mr. Cansdale as to the value of Mr. Raynor's paper and Mr. Harwood's notes, inasmuch as they recorded the results of *personal observation* in our own county, a cordial vote of thanks was returned to the authors.

The accustomed conversazione concluded the meeting.

Monday, May 29th, 1882.

This morning the exploration of the Loughton (or Cowper's) Camp, Epping Forest, commenced, and continued for 14 days. As the works were renewed on August 14th, a report of the whole investigation is given under that date.

Friday, June 9th, 1882.

In accordance with Mr. W. Cole's suggestion, adopted at the meeting of the Club on April 29th last, a "Conference" between the Verderers and some members of the Club was held on this evening, by the kind invitation of Mr. E. N. Buxton, at his house, "Knighton," Woodford, for the purpose of discussing certain points relative to the management of Epping Forest. Of the Verderers Mr. E. N. Buxton, Sir Fowell Buxton, Bart., and Mr. Andrew Johnston were present, and took part in the discussion. The claims of the lovers and students of Nature to whom the preservation of the primæval aspects of the Forest is a matter of the first importance were ably put forward by several well-known naturalists. Among the speakers were Dr. Henry Woodward, F.R.S., Dr. M. C. Cooke, Mr. J. E. Harting, F.L.S. (Editor of 'Zoologist'), Mr. Charters White, F.L.S., F.R.M.S. (President of the Quekett Microscropical Club), Prof. Boulger, F.L.S., Mr. Frederick Young, J.P. (President of the "Forest Fund"), and the President and Secretary of the Essex Field Club. Mr. W. G. S. Smith, Hon. Secretary to the "Forest Fund," was also present. The results of the Conference were considered highly satisfactory, the Verderers agreeing in the main with the views advanced as to the necessity for preserving the natural characters of the Forest, and promising to do all in their power to bring about a result so desirable.

Saturday, June 17th, 1882. A Visit to the Deneholes in Hangman's Wood, Little Thurrock, Essex.

Since the reference to the Deneholes made at our meeting at Grays on May 14th, 1881 ('Proceedings,' ii., xviii.), so much interest in these mysterious relics had been aroused that the Council determined to afford the members an opportunity of visiting them, as a preliminary step towards a more thorough exploration. Accordingly a Field Meeting was fixed for the above date, and the services of Mr. F. C. J. Spurrell, F.G.S., Mr. T. V. Holmes, F.G.S., and Mr. Henry Walker, F.G.S., were fortunately secured.

The literature of our Essex Deneholes, like that of the Epping Forest Camps, is imperfect in the extreme. Antiquaries and inquisitive folk of all degrees have visited them at intervals during at least the last 300 years, but in general they have been satisfied with the most superficial examinations, and content to propound theories as to the origin and use

of the pits, which have served to check and divert true scientific investigation. It is only of late years that the probable connection of Deneholes with the early history of man in Britain has been recognised, and the importance of a thorough examination of the few remaining perfect examples pointed out. It is quite unnecessary here to give any comprehensive account of these works as found in various parts of Europe, and (in England) particularly in Kent and Essex. Mr. Spurrell's learned and exhaustive essay, on "Deneholes and Artificial Caves with Vertical Entrances," in the 'Archæological Journal' for 1881, furnishes references to a vast number of writers, and is indispensable to all who wish to study the general subject. Mr. Holmes's paper "On Deneholes," in this part of our 'Transactions,' is a most welcome contribution to our knowledge; and Mr. Walker has given, in the 'Leisure Hour' for November, 1882, a graphic sketch, entitled "An Ancient British Pit-village," being an account of the Club's first visit to the "Denes," in Hangman's Wood. It may, however, be both useful and interesting to place on record a few references to the *Essex* Deneholes, which we have been able to meet with in various publications.

The earliest notice extant is perhaps that oft-quoted passage in Camden's 'Britannia' (first published in Latin in 1586), thus translated:—"Neere unto Tilbury there bee certaine holes in the rising of a chalky hill, sunk into the ground ten fathoms deepe, the mouth whereof is but narrow, made of stone [?], cunningly wrought, but within they are large and spacious, in this forme, which hee that went down unto them described unto mee after this manner." The woodcuts following are very rude and Chinese-like outlines, in which, as Mr. Spurrell observes, "Camden's imagination plays a large part; yet they are very interesting sketches, as being the first effort to portray the Deneholes, *and the only one*." He adds that the "cliff mentioned by Camden still exists, but the caves have either been filled in or cleared away for chalk. This I think to have been the case with some, as their remains were traceable in 1865, and perhaps now. The situation is remarkable, for the caves appear to go below the level of the tide of the river, which approaches very near, and in fact I believe has prevented the chalk from being worked as low as the bottoms of the caves, which are filled with ashes, soft pottery, bones, &c."

A curious passage in Dr. Robert Plot's 'Natural History of Oxfordshire,' published in 1705, deserves notice, as affording reason for believing that many of the Deneholes were visited in search of hidden treasures during the last 300 or 400 years. Speaking of the probable existence of *mines* of the precious metals in Oxfordshire (!), he says (p. 116):—

"... From all which it may be concluded that 'tis probable at least that here may have been formerly such a mine, stopped up, as I first thought, by the aboriginal Britons upon the arrival and conquests of the Romans or Saxons, who not being able to recover their country within the

memory of man, it might be lost like the Gold-mine of Glass-Hitten, in Hungary, when Bethlem Gabor over-ran that country, *or the Gold-mine of Cunobeline, in Essex*, discovered again Temp. Henry IV., as appears by the king's letters of Mandamus, bearing date May 11, An. II., Rot. xxxiv., directed to Walter Fitz-Walter concerning it, and since then lost again."

These golden visions of buried wealth appear to have gained considerable credence, and, according to a writer in the 'Cambrian Register,'* the "gold-mines" in Orsett, East Tilbury, and some of the neighbouring parishes, were actually worked at the commencement of the 15th century with *some degree of success* by the royal favourite above mentioned, who obtained a grant of them, which is still on record. A company of German miners were engaged, certain quantities of the precious metal extracted, and the prospects for a season appeared extremely favourable. That the scheme did not prove finally successful was attributed to the infidelity of the Germans, and to the domestic troubles of the times, which retarded their operations, and finally forced them from the country. Dr. Plot's remarks revived the craze, which was eagerly seized upon by some financial geniuses of the "South Sea Bubble" period to raise subscriptions from that faithful and long-suffering animal the British Shareholder; and a second Company was started in 1720 for extracting gold or silver out of the Chadwell earth, under the title "For Improving a Royalty in Essex," one of the arguments being that the unhealthiness of the air and the mineral springs about were proofs of the proximity of the precious metals! When the bigger bubble burst, this little Essex swindle collapsed also; and we only mention these schemes to show that a stronger reason than mere curiosity may have induced many to descend the Essex "Denes" generations ago, when more pits were open, and even the fact of a pit having been closed for years affords no guarantee that at a former period it has not been entered, and the soil and *débris* disturbed by some enterprising gold-seekers.

Morant, in his 'History of Essex,' gives some particulars of the Dene-holes, and quotes the following letter of the "learned and ingenious" Dr. Derham, F.R.S. (sometime rector of Upminster, and a friend of our great naturalist John Ray), dated 17th February, 1706, which is interesting, as being the first attempt at an accurate description of the pits in Chadwell parish:—

"I myself measured three of the most considerable holes, and found one of them 50 feet 6 inches deep; another 70 feet 7 inches; another in the wood northward 80 feet; the depth of the western hole near the road 55 feet 6 inches; on the same side of the road is another 70 feet 7 inches; on the other side of the way, in Hangman's Wood, is another hole of 80 feet 4 inches. A cow fell into the hole 55 feet 6 inches, not killed or much hurt; drawn up by a carpenter, who went down and put ropes about her. The bottom is soft sand, on which the cow alighted, and was

* "Historical Account, or an Inquiry into the Situation of the Gold-mines of the Ancient Britains," 'Cambrian Register,' vol. iii. (1818), pp. 31—58.

saved. Over the midst of the hole is an arch of 200 feet of chalk. These holes lie near the highway, within the compass of 6 acres of ground, leading from Stifford to Chadwell."

Morant adds that "in East Tilbury there is a field called Cave-field, in which there is a horizontal passage to the cavern." This latter, Mr. Spurrell says, is not now visible.

An amusing account of a visit to the Hangman's Wood "Denes" is given in the article in the 'Cambrian Register' for 1818, before quoted:—

"A gentleman of the cathedral of Canterbury, distinguished for his taste for Natural History, and his knowledge in the antiquities of his country, formed the extraordinary resolution of descending into one of these caverns. He was attended by an eminent surgeon from the neighbourhood, with the intention, no doubt, in case of accident, of availing himself of his advice and assistance. . . . . A rope was procured and thrown over a pully, attached to a neighbouring tree. To the lower extremity of the rope a strong piece of wood was horizontally fastened. Seated on this, and bearing a light, an *intrepid peasant*, who undertook to precede them, first descended. He had scarcely reached the bottom when, by some accident, the light was extinguished. His boasted courage forsook him, and he became terrified with horror at the apprehension of evils with which he was unacquainted, and dangers against which he was unprepared; and he thought he saw another pit still more profound and more tremendous yawning to receive him! Light having been again procured from a neighbouring farmhouse the other adventurers, unterrified at the peasant's fear-born exclamations, successively descended. The depth was about 70 feet. The different strata were accurately examined as they were passed, and found to consist chiefly of earth, gravel, and sand, and at the bottom appeared a bed of chalk. At the lower extremity of the shaft four excavations were horizontally made in four different directions; they were continued but a few yards, and were of no considerable depth. The fears of the peasant, that had been excited in obscurity, were not calmed at the appearance of the light, when he found himself standing on a *human skeleton* of gigantic size, most of the bones of which in his agitation he had trodden to pieces. At some distance lay on the ground the skeletons of several badgers, rabbits and hares, which were supposed to have fallen accidentally into this hideous gulf, as they gambolled through the woods or roved in quest of food. The human skeleton, it was conjectured, had remained there many years, as on being rudely touched it crumbled to pieces. No marks could be discovered on it that could lead to the decision whether it was the skeleton of a person who had been murdered and thrown there, or of one who, at some remote period, had fallen into this terrific cavern. The mouth of the pit is obscured by the shade of a tree, and the sides concealed by weeds and low brush-wood; an unfrequented path leads to a field from the road within a yard of the aperture; it is not covered, the ground is uneven and sloping towards the mine: '*Facilis est descensus averne*' can hardly to any place be more applicable. That such an accident should happen is not so much the object of astonishment, as that similar misfortunes do not more frequently occur. The head of the human skeleton appearing to be considerably above the common size, the Esculapian adventurer enveloped it in his handkerchief, but in his ascent he was more careful to preserve his own skull than that of the skeleton from coming into contact with the sides of the shaft, so on examining this *capital* object of

curiosity he had intended for his museum, on his arrival on firm ground he found it battered to pieces. This expedition into these subterranean regions totally failed in its intended effect; it did not decide the controversy relative to the original intention of the Deneholes." ("E. W." *loc. cit.* p. 55.)

In the 'Building News' for February 1st, 1867, is a paper on "British Caves on the Banks of the Thames," in which the writer repeats the ordinary information, and describes a visit made to the Denes in "Hairyman's (*sic*) Wood." He remarks that only five shafts were then open, but that at least twice that number had been accessible within the last few years. The party descended in the usual way, seated on a cross-stick attached to a stout rope, and they appear to have explored two of the holes with some care, but the writer confesses that he discovered "nothing which could give a clue to the purpose for which these singular excavations were made, or to the date of their formation, unless the pick-marks which we saw indicated that they were dug out, not with flint or bronze celts of the usual shapes, but with a metal tool like a pick of later date than the age of celts."

At a meeting of the Royal Archæological Institute on February 5th, 1869 ('Archæological Journal,' vol. xxvi., 191), Mr. R. Meeson, F.S.A., F.G.S., exhibited antiquities from Grays Thurrock, and made some remarks which are well worth attention:—

"The neighbourhood of Grays and the adjacent parish of Tilbury are full of remarkable vestiges, claiming careful examination. Mr. Meeson expressed a desire to invite the attention of archæologists to the prehistoric traces mingled with those of successive occupation in the Roman and subsequent periods, occurring in the neighbourhood of his residence at 'Duvals.' Among these he especially adverted to the deep cavities known as "Dane-holes" existing in every field where there is a substratum of chalk, and, he believed, originally formed in obtaining that substance for lime, as indicated by the frequent traces of burning that occur close to them; there seems, however, to be no doubt that the pits were afterwards used for other purposes, for burial and concealment. One, that he had opened, contained a large number of Roman urns, but the roof had fallen in and crushed them. In the débris of bones and chalk, Mr. Meeson found one of the verticilla before mentioned." ["Two verticilla or spindle-whorls—one of them lead and the other chalk—found in an urn with the armlets and bones supposed to be those of a female."]

In a subsequent communication to the Rev. Mr. Palin (printed in 'Stifford and its Neighbourhood,' p. 41), Mr. Meeson thus alludes to these specimens:—

"A curious feature of the district is the occurrence of the Dane-holes, as they are called by the country people, and of which antiquarians form such different ideas. I believe they are simply excavations to obtain chalk for lime-burning; subsequently, however, used for other purposes, as for burial in the Roman period. I have opened one full of Roman burial vases crushed by the fall of the roof, but from which I extracted

one nearly perfect, containing the bones of a female and child, with bronze armlets, and a spindle whorl of lead. I have never seen in them evidence of occupation as dwellings or stores. The method of obtaining chalk by this mode of sinking wells down to the chalk, and then driving tunnels, is now in operation."

The above is the only authenticated statement we have on record of the finding of relics in an *Essex* Dene-hole, with the exception of the pottery mentioned by Mr. Spurrell as existing in the shallow pits at East Tilbury. But unfortunately Mr. Meeson does not give the precise particulars required,—*viz.*, the depth and construction of the Dene-hole explored by him,—and we are left in doubt as to whether it had a deep shaft, like those in Hangman's Wood, or whether it belonged to the shallow class of pits found in many parts of England.

Interesting accounts of the Essex "Denes" are given in Palin's 'Stifford and its Neighbourhood' (1871) and 'More about Stifford' (1872), both privately printed.* We have already extracted from the latter work Mr. Williams's description of those in Hangman's Wood (see 'Proceedings,' vol. ii., p. xviii.). A rough map of the wood and plan of one of the holes is given. Mr. Williams enumerates fifty holes, of which six were then open; there are in reality seventy-two, and, as Mr. Spurrell remarks, "those in the western portion of the wood are mapped in the six-inch Ordnance map; the eastern division, perhaps from some red-tapeism, being unmapped, though, if anything, they are the most conspicuous holes." The pits are so close together that Mr. Williams asserts that when a sharp sound is made in an open hole the reverberation occasioned by the underground cavities of the adjacent closed ones can be easily recognised. He also speaks of a Dene-hole partly filled up in the Stifford Chalk-quarry, and of "a series of them in Mucking Woods filled up within the last few years." These last were in *sand*, but once probably extended down to the chalk. Mr. Spurrell says:—

"Others in clusters of three or four are to be found on either side of the little valley leading from Hangman's Wood southward to the Thames. . . . . From Stifford along the Mardyke, or Merydike, stream to Purfleet, these caves are found on either side, the chalk being white on the surface. The ground around them near Purfleet is covered with Neolithic flakes, which may be scraped up by the hand. The pits now filled in completely must have been of very slight depth, otherwise

* The Rev. William Palin, M.A., for nearly fifty years Rector of Stifford, died on October 16th, 1882, aged 79 years. He was a thoughtful and energetic writer on Church affairs, his most important ecclesiastical work being 'The History of the Church of England, 1688—1717,' and he was formerly editor of the 'Churchman's Magazine.' His two books on his own and neighbouring parishes abound in topographical and physical details, and present a welcome contrast to the ordinary dull county history, filled only with the rise and fall, the marriages and deaths of the "great" families; the details of architectural lore and local history being interspersed and relieved in a delightful way with little flashes of dry humour, and telling anecdotes of life and manners in former days.

they would have been below tide-mark, as the land now lies, when dug. The pits down by the Mardyke stream have had one or more ditchways leading to the point of land on which the powder magazines stand. That and the Beacon Hill appear to have been Neolithic dwelling sites (for which they were well suited) if only from the signs of flint chipping to be seen there plentifully" (*loc. cit.*)

Mr. Spurrell has kindly given the Editor a tracing of the positions of these holes and Neolithic stations.

As bearing on the probable connection of the "denes" with the early British, we may refer to a statement given in an account of the opening of a *British Tumulus* in Norsey Wood, near Billericay, Essex, in the 'Building News' for February 22nd, 1867, p. 141:—

"Not far from the first of these tumuli was an excavation, like a small deep gravel-pit, which one of the labourers said his father told him was a 'dane-hole' which had caved in. He had had the curiosity to dig into it here and there to about the depth of three feet, but 'found nothing except a few broken tiles.'"

In the above summary of the published accounts of our Essex examples, we have neglected those numerous letters and articles in periodicals which merely put forward one or other of the hypotheses which have been devised to account for the existence of the dene-holes. The early writers appear to have approached the truth more nearly than their modern followers (the "gold-mine" legend, we suppose, never deceived any but the "gulls" of the money market). That they were store or dwelling-houses is the opinion of Mr. Spurrell and Mr. Holmes, and, with all respect for former writers, we think we may safely assert that no other archæologists are so capable of forming a sound opinion. In excavating the shafts and chambers large quantities of chalk and some flint would be removed, and were possibly utilised, but a little consideration of the facts and arguments in Mr. Holmes's paper will convince most readers that these were secondary advantages, and not the principal aim of their constructors. The *age* of the deep "denes" of Kent and Essex is still an exceedingly doubtful point; they are probably not so ancient as the shallower pits found elsewhere, but only future investigation can decide where the available evidence is so scanty and obscure.

On the Wednesday previous to the meeting Mr. Spurrell and the Secretary visited Grays to make the necessary arrangements, and to examine some old chalk workings discovered on June 3rd at Messrs. Brooks, Shoobridge, and Co.'s chalk-pit, about one and a quarter mile from Grays, towards Purfleet. Mr. Herbert Brooks kindly made a plan of the workings (which is deposited in the Library) and furnished the following particulars:—The workmen broke into the workings at a distance of ten or twelve feet below the surface, at the spot enclosed with dotted red lines on the plan. The extreme length of the principal gallery exposed was about sixty-five feet; it ran north and south, with side

galleries of varying lengths turning out of the principal one at right angles (east and west). The galleries had arch-shaped roofs, and varied in height from seven to twelve feet, the workings inclining downwards and becoming deeper as they went north. Some of the galleries widened out at the ends, and formed small chambers, and in one or two instances it was observed that the roof of the chamber was considerably higher than the gallery which led to it. The entrance appeared to have been from the southern end, but as the earth had fallen, or had been filled in there, nothing decisive could be said as to the exact position of the original entrance. The marks of the picks were as plainly visible as though just made, and one pick appeared to be "square-pointed," so to speak, and half an inch broad, whereas another was only a quarter of an inch broad.

Under Mr. Alfred Brooks' guidance, Mr. Spurrell made a careful examination of these chalk workings, and he came to the conclusion that they were comparatively modern, and had no necessary connection in point of date or intention with the Dene-holes in Hangman's Wood and elsewhere. It was suggested with some show of probability that the galleries may have been used as store-houses for smuggled goods, and that entrance was obtained by a short shaft from the field above the workings. No trace of human or other occupation could be detected, with the exception of a small heap of bones, apparently those of a bird.

On the morning of the day of meeting several members journeyed down to Grays by an early train, the party including the conductors, Mr. Worthington G. Smith, Dr. Cory, Mr. W. Crouch, and the Secretary. We were met at Hangman's Wood by Mr. Biddell (agent to Capt. Wingfield, the owner of the wood). who had very courteously given full permission to the Secretary to conduct any operations considered necessary; also by Messrs. Herbert and Alfred Brooks, of the Grays Chalk Quarries, whose firm had furnished a horse and cart, with the requisite "tackle," and three of their best workmen to handle it. Although the wood is not more than a quarter of a mile square (see Plate II.), it contains evidence of the former existence of at least *seventy-two* Dene-holes; the majority of these are "filled up," either naturally or artificially. The filled-up examples are about 30 feet across, and 6 or 8 feet deep, and form deep basin-like depressions. In several instances the whole cavern beneath had evidently fallen in, and quite a chasm in the soil bore witness to the calamity. Many of the closed examples are probably not entirely filled up from top to bottom, but the falling in of boughs of trees, showers of leaves, and the rain-wash of Thanet-sand, gravel, &c., from the sides, has gradually made a kind of plug or cork, above which more soil has accumulated. We were told, in confirmation of this view, that a "filled-up" hole had recently opened itself again, the plug of leaves and soil dropping to the bottom of the shaft. Each open hole presents a funnel-shaped aperture, some 20 feet across, gradually shelving down to a

circular shaft about 3 feet in diameter. As Mr. Walker says,* "They are entirely unguarded from the approach of the wayfarer, and incredibly dangerous. Wild flowers lead you on inadvertently to the sides of a small and inviting dell, and it is hard to stop yourself from sliding down the grassy crater right into the mouth of the unseen pitfall in the centre. Happily you perhaps hold on by a friendly root or twig, and so peer down the circular shaft into the dark and unknown depths below." At one time many were wired over, not, however, for the safety of human beings, but to prevent the loss of dogs and foxes!

Planks had been thrown over an open shaft at the entrance to the one on the right-hand (No. 1, on small plan on Plate II.), and a pulley slung from poles, the rope being worked by a windlass. At first the explorers stepped into a square box, and were lowered down the shaft one by one; but the box was soon disestablished in favour of a stout piece of wood, on which one after another sat astride, and were slowly lowered down the shaft to view the subterranean chambers. The funnel-shaped hole quickly contracted to about 3 feet 6 inches in diameter, and all who went down into the pit soon bore upon their clothes ample evidence of the narrowness of the duct. Back, elbows, knees, one after the other scraped the sides of the shaft as the rope revolved; and there was a notable difference between the trim appearance of a gentleman before his descent and that which he presented when he reappeared on the platform, fancifully adorned with streaks of earth and chalk! At about 58 feet from the surface chalk was reached, but before getting to this the visitors alighted upon an immense conical mound of Thanet-sand, gravel, and surface soil, partly *débris* from above, and partly formed by the falling in of the roof of the chamber at the bottom of the shaft. The chalk roof to the chambers was only 2 feet in thickness, quite insufficient to bear the superincumbent strata, and the heavy fall of sand had completely blocked up all except two chambers, if more existed. (See No. 1 Pit, Plate II.) "Foot-holes" were clearly traceable almost all down the shaft,—holes just large enough for the foot to enter, and evidently the means by which the makers of the pits descended and ascended, before denudation had widened the mouth of the shaft.† The depth of the floor

* In his article in the 'Leisure Hour,' referred to above. The Editor gladly acknowledges his indebtedness to Mr. Walker's paper, Mr. Worthington Smith's note in 'Gardeners' Chronicle,' and to the reports in 'Essex Times,' for many details.

† At the visit made by the Lewisham and Blackheath Scientific Association to a Dene-hole in Stankey Wood, Bexley, two of the visitors ascended about 20 feet, and descended again by means of similar foot-holes (see Proc. Geol. Assoc., vol. vii., p. 401). Mr. Spurrell says of the foot-holes of this Stankey pit that "they are opposite to each other, about 18 inches apart, and mostly 6 inches deep, some reaching 20 inches. I supposed that these latter were for sticks or poles to be inserted as rests, but on trying one I found such poles very difficult to pass, unless indeed the whole of the passage down was made into a kind of ladder. It is noticeable that anyone below inserting a pole across the shaft could easily prevent anyone descending. The Thanet sand bears the wear and tear of use well, but in the lapse of years, perhaps to be counted by thousands, many of these pits, which were once descended by holes, have got too wide for the stride of any man." (F. C. J. Spurrell, in Archæol. Journ.)

of the two remaining chambers from the surface was about 71 feet, the height of the chambers about 11 or 12 feet, and the extreme length from the base of the shaft about 40 feet. At one time this "dene" had been in all probability much more perfect and extensive, but as many of the chambers (supposing others existed) were blocked up, and the place appearing dangerous owing to the tendency of the thin roof of chalk to give way, the scene of operation was changed to another pit, a little further on, on the same side of the woodland path.

To quote Mr. Walker's description, this pit (No. 2, of small plan on Plate II.) was "of a decidedly romantic and suggestive exterior. It was well protected by overhanging trees and a shroud of honeysuckle; indeed it was so well concealed as to give a vivid idea of the times when such natural screens were of vast importance to the owners or occupants. Our men were soon at work with their bill-hooks, the platform and winding-gear were again erected, and the descent safely effected. Again foot-holes were found on the sides of the shaft, and again at the base we landed upon a huge heap of rubbish, the accumulation of untold years. Proceeding cautiously with our lanterns, and planting a lighted candle every few yards, we soon found that we were in a typical Dene-hole, in an excellent state of preservation."

A section and ground-plan of this No. 2 pit are given on Plate II., from drawings and measurements of our conductor, Mr. Holmes. On descending the pit the roof of chalk was reached at 60 feet; the roof was much more substantial than that of No. 1 pit, being at least 6 feet in thickness, and in consequence it was intact, except in one chamber, where a slight fall had taken place. The extreme depth of the shaft was 80 feet, giving access to five large chambers, averaging 15 feet in height, varying from 30 to 40 feet in length, and from 10 to 12 feet in width. In the chamber where the roof had partially fallen in, a small accessory chamber, only to be entered by crawling through the opening on one's hands and knees, had been excavated near one end; this our experts thought might be of later date, and not necessarily designed by the original architects of the pit, who appear to have had correct notions of symmetry and proportion.

The purity and comparative freshness of the atmosphere of the chambers struck many with surprise. There was no indication of the presence of the deadly "choke-damp," carbon dioxide, so commonly found in the stagnant air of old wells and pits. Of course it was to be expected that quantities of the gas would be set free in the decomposition of the vegetable refuse fallen into the pit, but some of our chemical visitors suggested that the damp chalk might itself absorb the gas as fast as set free, forming a double carbonate of calcium ($CaH_2(CO_3)_2$), such as is supposed to be produced when carbon dioxide gas is passed in excess into lime-water.

The chalk was in most parts as white as snow, and the innumerable marks of the picks (*metal?*) were as sharp as if just made. Many small blocks of chalk had fallen from the roof, but in some places the original

floor was visible. In view of the number of visitors present (the bulk of the party came down by the 2.27 train from Fenchurch Street to Grays) it was impossible to usefully make more than a very superficial examination of the conical mound of *débris*, under which some traces of the original owners of the pits might be found. We noted some bones of rats, rabbits, dogs and foxes. The rabbits and rats had made burrows in the fallen sand, and the deep striative marks of claws on the sides of the base of the shaft told a sickening story of the lingering death of many a poor dog. A large number of sticks and stems were littered about the floors; and Mr. Worthington Smith observed that these supported a good crop of fungoid life, both in the form of dense mycelium, and the more perfect state of *Corticium* and other fungi.

No worked flints were discovered in the pits themselves, but around the mouths and in the fields adjacent many flint "flakes" and "cores" were picked up. In the immediate neighbourhood of the pits Mr. Smith found a small, well-made Neolithic flint-knife, with secondary working on both sides; length $2\frac{1}{8}$ inches, width 1 inch.

The rival theories as to the purpose of the Dene-holes were discussed during the few minutes that remained after the usual Club tea, admirably served by the attentive and obliging host and hostess of the "King's Arms Hotel," Grays.

The President said the chief business they had to transact was to record their thanks to the several gentlemen who had so kindly given their assistance; to their conductors, Mr. Spurrell, Mr. Holmes, and Mr. Walker; and to Mr. Biddell for permission to explore the holes in Hangman's Wood. The proceedings had also been helped very much by the great courtesy which they had met from Messrs. Brooks, Shoobridge & Co., the admirable arrangements they had made for the Club having enabled them to examine these Dene-holes with ease and safety. He moved a vote of thanks to those gentlemen for their assistance. [Applause.] There were a few moments left before moving to the station, and he thought that the subject of Dene-holes was so interesting that they ought not to let the matter entirely drop. He was sorry to say that Mr. Spurrell had been obliged to leave, but they still had Mr. Holmes, Mr. Walker, and Mr. Worthington Smith with them, and would be glad to hear any remarks they had to make on the subject of the afternoon's explorations.

Mr. Holmes said he had been very much interested in their day's examination. He thought the Society was doing an excellent work in calling attention to these Dene-holes, because a year or two ago their existence was almost entirely unknown to the scientific public. He had noticed on the part of geologists a reluctance to admit the existence of any holes except for the purpose of obtaining chalk or flint. Those holes which they had seen were clearly not for that purpose, for though there were broad stretches of chalk close by, the makers had chosen to go through between 50 and 60 feet of Thanet sand first, which they would hardly have done to get chalk or flint. Curiously enough the strata at

Hangman's Wood were precisely those through which the Bexley holes were sunk, and they had noticed in the first case that day, that, in consequence of not having a sufficient thickness of chalk in the roof, a great fall had taken place. In the second hole, where there was a thickness of 6 feet or more of chalk in the roof, no fall had taken place worth speaking of, except in one corner. This proved the necessity for sinking the chambers well into the chalk, a fact probably known to the men who made them. If asked the purpose of the deep Dene-holes, like those visited that day, he would say, as at present informed, that they were intended as places of occasional refuge in times of danger, and as *store-houses*.

Mr. Walker said that as he was coming down there he happened to light on a neighbour of his who knew India and China exceedingly well. He had told this gentleman the purpose of the excursion, and he said, "I have been very much interested in seeing similar excavations in the northern part of Asia and the Himalaya mountains. There the natives choose similar places as store-houses for grain, and call them *pootahs*." He had also seen the same thing in Delhi and in China, and the same screen was always chosen—a wood. These places, which were obviously old places of storage and retreat, belonged to a very unsettled state of our country,—perhaps before the Saxon settlement, perhaps before the Roman settlement,—evidently to a time when it was quite unsafe to garner the produce of a field in the open field in the shape of ricks accessible to incendiaries or to prowling bands. Supposing they belonged to a certain early aboriginal state of society, he thought the fact his friend Mr. Holmes had mentioned—that the deep Dene-holes were almost invariably in a limestone formation—showed that people in different parts of the world, and in the same stage of civilisation, adopted the same means to preserve their goods. These were evidently prehistoric, and belonged to an incipient stage of society. We had now a means of establishing the date of archæological structures which we did not possess before the discovery of stone implements, and a new interest had been given to such remains; and though they had not had time that day to make proper excavations, still he believed that they were Neolithic, Neolithic implements having been found abundantly in the vicinity.

Mr. Worthington G. Smith said he felt bound to somewhat differ from the two last speakers, for his impression was that the holes were excavated chiefly as quarries for the flint with which to make stone implements, it being a well-known fact that newly quarried flint is more tractable for manufacture than flint that has been exposed on the surface. He referred to other pits, as those in Kent, at Brandon in Suffolk, Cissbury near Worthing, Spiennes in Belgium, and other places, and said that the excavations commonly ceased when a good floor of flint was reached, and when one floor was exhausted another was dug for; that the excavated flints had been found at the bottom ready to bring up, and implements in every stage of manufacture at the top of the pits. He would not deny

that the pits might have been utilised for other purposes, but he said they were unfit for residences; a short stay in such damp places would soon destroy anyone with consumption, ague, rheumatism, and fever; neither did he consider them places of refuge; to go into such places for refuge would simply be to go into an open trap. The woods would be far safer for refuge than a hole in the ground. As for their being granaries and places for storing corn, he well knew as a fungologist that corn placed in such a position would be immediately and utterly destroyed by mildew. Corn to be kept good must be preserved in a dry barn. Some archæologists were always talking about the ancient Britons' *enemies*, as if they were always fighting like tribes of wild Indians; such speakers forget that the Britons were a pastoral people, with farms, farm implements, herds, flocks, and dogs; they were not always fighting and running into perpendicular shafts 80 or 90 feet deep. What would become of their oxen and sheep under such circumstances?

The President remarked that in the explorations made at Cissbury by General Pitt-Rivers and Mr. Harrison, they found a deer-horn pick in the position where it was evidently left by the workmen. Therefore there was evidence that they did tunnel into the chalk, and he was disposed to think that Mr. Worthington Smith might be right in that. But he did not see why these Dene-holes should not have been used successively for different purposes. If they were used in Neolithic times for flint-making, in later times they would have been taken advantage of for other purposes.

Mr. Holmes said he had simply urged that the pits they had visited and those at Bexley were not such. No people in their senses wanting to get flints would begin in a stratum 50 feet above the chalk. They would begin near the chalk, as they had done at Cissbury and other places.*

Mr. Worthington Smith asked what proof was there that these old excavators ever dug into the chalk at Grays Thurrock? There are plenty of pits now, but it does not follow that the pits were there a thousand or two thousand years ago. In the last hole descended there was one large flat place at the exact position where a band of flints had occurred; every flint was removed from the flat place, and not an inch of the chalk disturbed below. Still it was possible, and perhaps probable, that the Dene-holes were used for other purposes, as well as for quarrying flint; and the Essex Field Club might profitably employ some of its time in an attempt to solve this point.†

The friendly discussion at the tea-table was somewhat prematurely cut short by the necessity for catching the return train from Grays, but it was continued on the way to town, the preponderance of argument being

* For Mr. Holmes's arguments at length, see his paper on Dene-holes in this volume of the 'Transactions.'—Ed.

† We understand that Mr. Smith has since considerably modified his views as to the probable intention of these *deep* Dene-holes (see report of Meeting at Grays, on September 9th, 1882, *infra*).—Ed.

decidedly in favour of the theory that the Dene-holes were constructed as safe storages, and perhaps as safe refuges upon occasions. A strong desire was expressed that the Club should take the subject systematically in hand, in the hope of obtaining evidence which would enable us more easily to decide upon the nature and use of the Essex and Kent Dene-holes, their period in the slow development of human civilisation, and to realise in some faint degree the life and habits of the men who made them. As Mr. Walker said, such studies can scarcely fail to humanise and instruct, "telling us of human lives and interests in that unknown time, precious then as now, precarious though the tenure of life might be. They will perchance deepen our sense of the hardiness, endurance, and privation which have contributed in their measure to the life of our England of to-day."

Saturday, July 22nd, 1882.—Field Meeting.

The Club, under the guidance of the President and Secretaries, assembled at Buckhurst Hill Station at 3 o'clock, and after the microscopes and specimens, with which some of the members were loaded, had been deposited in a carriage for conveyance to Chigwell, the company (about forty in number) started for a charming country ramble to the Rev. W. Linton Wilson's residence, "Oakhurst," he having most hospitably invited the Club to visit him at Chigwell. The scientific director of the meeting was Mr. W. Saville Kent, F.L.S., one of our honorary members; and we had with us also Dr. Cooke, Mr. W. W. Reeves, F.R.M.S., Mr. Arthur Lister, F.L.S., Mr. Oxley, F.R.M.S., Mr. Letchford, F.R.M.S., Mr. Thomas, F.R.M.S., and several other practised microscopists and botanists. The guides led the way through the pretty isolated portion of Epping Forest, known as "Lords" or "Lodge" Bushes, and so into a lane (commonly, but, we understand from Mr. D'Oyley, erroneously, called "Squirrel's Lane") refreshingly rough, untrimmed, and unimproved, with tangled grass and sedge, amid which many wild flowers nestled and hid their modest charms. Betony and Woundworts, Self-heal (*Prunella*), Skull-cap, *Veronica*, plenty of Trefoils, Clovers, and Vetches, flourished everywhere, whilst with more vigorous growth the giant Umbelliferæ thrust themselves into notice, the branching heads of small white flowers contrasting well with the dark green hedgerows of maple, nut, and ash, in which the Black and Red Bryony, Convolvulus and Bed-straws lovingly twined and blossomed. Here were noticed *Vicia hirsuta*, and the delicate little Vetch, *Vicia tetrasperma*, many of the pods of which contained only three seeds, provokingly defiant of its learned name. Also many splendid plants of the ever-welcome St. John's-wort (*Hypericum perforatum*), the slender woodland beauty (*H. pulchrum*) having been already noticed in Lord's Bushes; and to crown the whole, tall plants of Meadow-sweet waved masses of yellowish white flowers

above their fellows, and gave the charm of odour. The way taken was across the alluvial meadows of the Roding River, from which the hay had hardly been carted, to the little White Bridge at the "Cascade," guarded by three fine (Wych?) elms, and so to the site and remains of "Luxborough House," a low-lying homestead, surrounded by luxuriant fruit-gardens, now in the occupation of Messrs. Cowe and Tidball, who very kindly threw their grounds open to the party.

Here a long halt was called to enable our "Pond-hunters" to make innumerable experimental dips with little bottles, hooks, and nets, into the weedy moat and ponds. All were soon at work, Mr. Kent being very desirous of obtaining fresh examples of water-mites (called by the initiated *Hydrachnidæ*) for exhibition later on. They were scarce, and only a very few could be fished up, but Mr. Kent identified the following species:—*Nesæa convexa*, Koch; *N. fuscator*, Koch; *Marica musculus*, Müller, sp.; *Arrenurus globator*, Müller, sp.; *A. buccinator*, Müller, sp.; *A. maculator*, Müller, sp.; *Limnesia fulgida*, Dugés.

The curious little "Water-fleas" (*Daphnia* and *Cyclops*) were in excessive numbers, and Mr. Oxley soon dipped sufficient to make the contents of his collecting bottle assume a very lively appearance, thousands and thousands of the active creatures (nothing to do with real fleas by-the-bye, being distant relations of the lobsters) darting and dodging through the water like a swarm of aquatic bees. Many strange and bizarre forms of life met our gaze in the bottles as they came up with samples of the ooze and water of the ponds; but though their size was small their names were Johnsonian and terrific, and such words as Entomostraca, *Paramæcium*, *Vorticella*, and *Planaria*, were freely bandied about by our experts. Mr. Thomas had visited the ponds and river the previous day, where he found the Fresh-water Sponge (*Spongia fluviatilis*), and the following species of Infusoria:—*Anthophysa vegetans*, Müller; *Opercularia nutans*, Ehr.; *Vaginicola crystallina*, Ehr.; *V. tincta*, Ehr.; *Ophrydium eichornii*, Ehr.; *Acineta mystacina*, Ehr., var. (a form which Mr. Thomas thought might be a new species, but which Mr. Saville Kent has referred to the var. *longipes* of Mereschkowsky.—See 'Manual of the Infusoria,' 834.)

Dr. Cooke and Mr. English of course kept a sharp look-out for any stray Fungus:—*Agaricus* (*Collybia*) *dryophilus*, Bull., *A.* (*Clitophilus*) *prunulus*, Fr., *A.* (*Inocybe*) *rimosus*, Bull., and *Russula furcata*, Fr., were identified; and at the foot of an elm tree a fine group of *A.* (*Psathyrella*) *dissemiatus*, Fr., gladdened the eyes of our mycologists. Many flowering plants were noticed, but all common species—*Galium verum*, *Lythrum*, *Nasturtium*, and plenty of *Rumex hydrolapathum* in the ditches. A sharp shower once drove the naturalists to the shelter of the walls and garden-houses, and after the fishing was over the party gathered together in the flower-garden, where an abundant supply of summer fruit, fresh gathered from the grounds, with milk from Mr. Chilton's farm, was provided by the thoughtful kindness of the President and Secretary. Mr.

Fisher Unwin gave a short account of the old Luxborough House, of which only some portions of the outbuildings and the extensive garden-walls now remain. Mr. Unwin said that the first mention he could find of the manor was in 1605, when Sir Robert Wroth died seised of it, and since then it had always passed with the adjoining manor of Chigwell Hall. Early in the last century the demesne lands were purchased by Robert Knight, cashier to the famous swindle, the South Sea Company, who pulled down the old house and built a mansion. This was seized by the Company when the crash came, but it was eventually re-purchased by Knight, who was succeeded in 1744 by his son. Robert Knight was created an Irish peer in 1746, by the title of Baron Luxborough, and in 1763 Earl of Catherlough. He sold the estates in 1749, and they came in rapid succession through various owners, including Sir Edward Walpole, to Sir Edward Hughes, an eminent naval officer, who made it his country house, and died there in 1794. His widow, Lady Hughes, sold the estates in 1799 to James Hatch, of Clayberry Hall, who had long wished to obtain them, and he immediately pulled the house down. Tradition says that he could not bear that there should be a grander house than his own so near.

Neither Mr. Unwin nor Mr. Walter Crouch (to whom we are indebted for this slight sketch) had been able to find any mention of the original Manor House; and therefore we may fairly presume, in the words of the latter gentleman, "That it was not one above the usual average of such buildings; but the one built by Robert Knight—and this in less than a century razed in a fit of jealousy—was of large and even imposing appearance, square built, probably of Portland stone. It must have been, judging by the engravings, by which alone we know it, to some extent a rival (and perhaps a partial copy) of the magnificent house which Sir Richard Child built in 1715 at Wanstead—having like that a fine portico in front with six Corinthian pillars supporting a pediment, and with bold cornice and balustrading over the wings. It faced the pond which still remains on the other side of Luxborough Lane. On the left was the garden, facing the lawn, and on the right a courtyard with outbuildings and stables, one of which with weathercock on top still remains. *Sic transit gloria mundi.*"

Mr. Unwin alluded to the mention of Luxborough as a locality for plants by Richard Warner in his 'Plantæ Woodfordienses,' and exhibited some views of the house.

The party then left the fruit-garden and walked through the lane to Chigwell, making frequent stoppages by the way to examine some pond or wayside weed. In a pond lying in a portion of the scanty remains of the once grand forest of Henault, Mr. W. W. Reeves (Assistant Sec. to the Royal Microscopical Society) pointed out a quantity of the water thyme or American weed (*Anacharis alsinastrum*) in vigorous bloom. It is seldom found in flower, and only *female* blossoms are generally found, the male flowers being extremely rare in Britain, and have been observed by very few botanists. Perhaps it is a happy circumstance for the keepers

of rivers and ponds that this is so. The plant was first noticed in England about 1847, and is now a pest in almost every river in the country; were sexual reproduction added to its marvellous powers of increase by the growth of the most minute fragments, all our streams would soon be choked.

At Chigwell all were safely housed under Mr. and Mrs. Wilson's hospitable roof, where a hearty welcome was found.

After tea an Ordinary Meeting (the twenty-ninth) of the Club was held, the President in the chair, who commenced the business by proposing a hearty vote of thanks to their kind host and hostess for the reception given to the Club that afternoon.

Mr. Henry Walker seconded in a few felicitous words, and the vote was given by acclamation.

Mr. Wilson in reply said that every member of the Club was most welcome, and he hoped such meetings would bind them more and more strongly together as a brotherhood united by common feelings and wishes to study Nature, and enjoy the charms of the country.

Messrs. Robert H. Eve and J. H. Porter were balloted for, and elected members of the Club.

Mr. Saville Kent then gave a short address on—

The Study of the Water-Mites or Hydrachnidæ.

Some ten or twelve years previously he had devoted a short interval to the study of this group, and now proposed to take it up again and as far as possible work out a monograph of the British species. The Hydrachnidæ constituted a distinct family of the Acarina or Mites, of exclusively aquatic habits, and specially adapted by the development upon their limbs of long fine swimming-hairs for leading a natatory existence. The majority of the members of this group are eminent for their brilliant colorations—scarlet, crimson, green, yellow, and brown being among the predominating hues. With but little trouble they may be mounted as permanent objects for the microscope, and thus constitute in connection with their bright colours and often grotesque shapes a valuable accession to the collector's cabinet. By keeping the species isolated in separate bottles it is easy to arrive at a knowledge of their entire life-history. Small Entomostraca, such as Daphnias or Ostracoda, should be supplied every few days as food; the Hydrachnidæ, like their congeners the true Spiders, being eminently predatory, and requiring a constant supply of living pabulum. A small fragment of water-weed should be likewise added to each bottle for the little creatures to eat and deposit their ova upon. These ova, which generally partake of the brilliant colouring of the adult mites and form exquisite objects for the microscope, especially when viewed with the aid of the parabolic illuminator, are enclosed within a transparent, often delicately reticulate film of mucus, and give birth, usually at the end of a fortnight, to minute hexapod *larvæ* totally unlike the parents. In some cases these larvæ throughout their development to the parent form maintain a similar free swimming existence; but in more exceptional instances they attach themselves as parasites to various water-insects, and under these conditions undergo their metamorphoses, which consist of periodic castings of their skin or ecdysis, by which process the normal number of appendages, and eventually the characteristic size, shape, and colour of the adult, is arrived at.

So far no data had been placed on record concerning British species of Hydrachnidæ. Mr. Saville Kent had, however, succeeded within the course of two summers, 1868 and 1869, in collecting upwards of fifty varieties within the neighbourhood of London, and upon such a substantial foundation hoped soon to be in a position to make a first report upon the indigenous species. The assistance of the members of the Essex Field Club in working out the Hydrachna fauna of the Epping Forest district was earnestly solicited.

Mr. Kent illustrated his remarks by the exhibition of living and preserved specimens of numerous species under the microscope (including ova, hexapod larvæ, and adults), and a number of exquisitely-coloured drawings. Many of the preserved specimens, although prepared as long as fourteen years ago, still retained their original brilliant colouring. The medium employed for their preservation was, in most instances, a weak solution of alcohol, *i. e.*, one of spirit to four or five of water. The lifelike extension of the limbs notable in all the specimens exhibited was accomplished by the momentary immersion of the animals in boiling-water. For arriving at a correct knowledge of the characters of the oral apparatus, with the accompanying palpi and mandibles, it would be necessary to crush or dissect examples, and mount the parts as transparent objects in balsam.

The President initiated a short discussion on the mode of development and ecdysis or shedding of the skin in the larval forms of the Hydrachnidæ, and then called upon Mr. Arthur Lister, F.L.S., who read the following note :—

On the Parasitism of Rotifers in Cysts on Vaucheria.

"On the 23rd of February, 1882, I gathered *Vaucheria geminata*, Vauch., var. *racemosa*, Hass., and *V. aversa*, Hass., growing together in full fruit in a pond near Wanstead Church, Essex.

"On examination I noticed growing out from the stems of the plants, and occasionally from the extremities, many clavate green capsules, from five to ten times the breadth of the stem in length, often crowned with from two to four horn-like processes, and almost invariably containing one, but in a very few instances two, 'Wheel-Animalcules' (Rotifers), which were observed feeding upon the chlorophyll-granules lining the walls of their cage, picking off the granules with their much-extended and pointed mouths, reminding one of the way in which earthworms feed upon a dead leaf.

"In the older capsules, from which almost all the chlorophyll had vanished, the animal exhibited very sluggish movements. It was nearly globular in form, the anterior and posterior extremities slightly projecting; a large dark granular spot (the liver?) occupied the central region, a rotatory disc could be detected at the mouth, also two red eye-spots, a ciliated alimentary canal, a gizzard of apparently simple structure, and a contractile vesicle above the short bifid tail. The creature was distended with eggs, and was surrounded by free eggs, often as many as fifty in number, which completely filled the chamber.

"In many of the capsules a writhing movement was observed within the egg; in others, some or all had hatched, and the young were actively moving about their enclosure, or making their way along the dead stems of the *Vaucheria*, with which the capsules had free communication. I noticed two or three of these young ones crawling outside the plant, but whether or not they had escaped from broken stems I could not determine.

"The water contained a considerable number of Rotifers, mostly of the species I took to be *Pleurotrocha gibba*, and a few *Rotifer vulgaris*.

"In a specimen of *Vaucheria dillwyni*, Ag., gathered from a damp cart-rut on March 15th, I found a few capsules similar to those described also containing Rotifers, having the same appearance as those found in the pond. On placing the plant in water I found it on the following morning discharging motile spores from the extremity of its threads, a character common probably to all the species of *Vaucheria*. Now the question that puzzled me extremely was, how did the Rotifers gain admission into the vigorous green *Alga?* and what gave rise to the remarkably large capsules

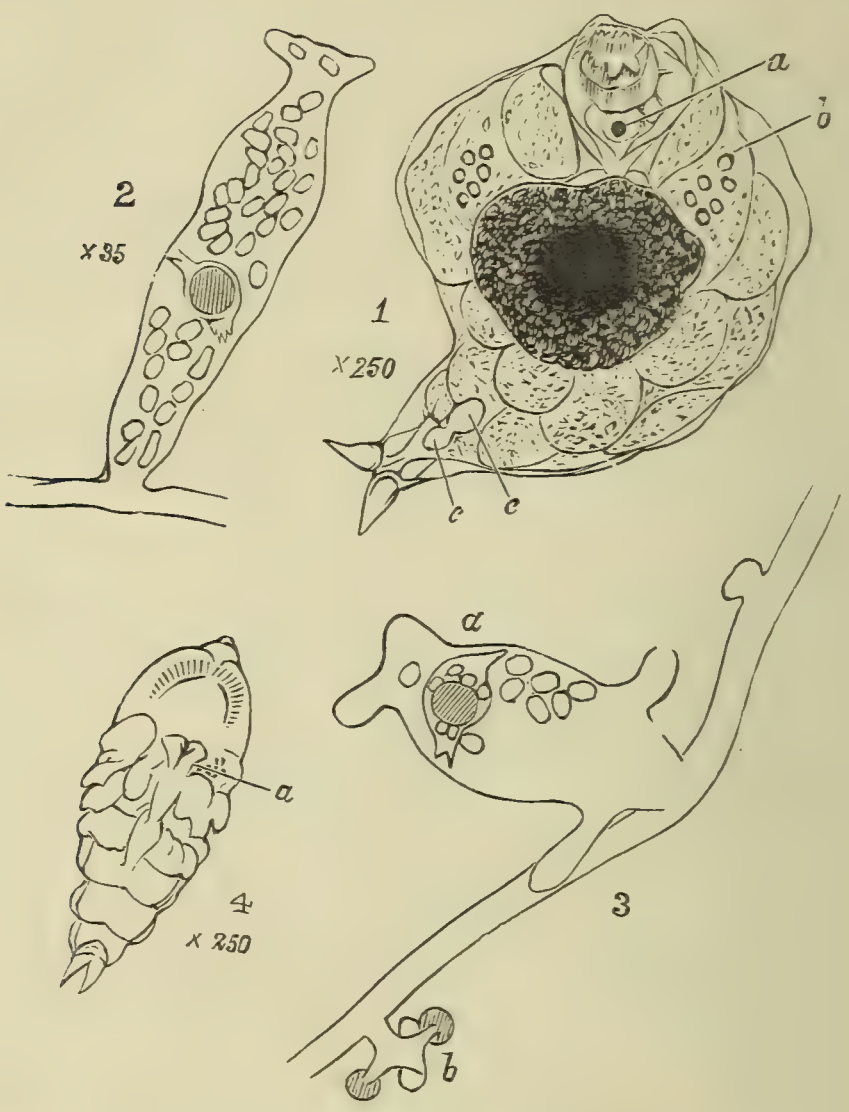


FIG. 2.—The Rotifer Parasite on *Vaucheria* *

invariably tenanted by these creatures? Is it possible that the *Vaucheria* is selected as a favourable nidus, and the abnormal growth produced by some stimulating action on the same principle as *Cynips* occasions the galls on the oak-leaf? though in this case it would be impossible for the large eggs to be inserted into the plant, not to mention the fact that the eggs are apparently all produced by the animal after its inclosure in the capsule; for I should mention that in the youngest capsules the creature is much more slender in form than it afterwards becomes, and the eggs are quite rudimentary. If the plant is really selected as a fit

* The Club is indebted to Mr. Lister's kindness for this cut, engraved by Messrs. West, Newman & Co., from his own drawings.—ED.

breeding place, however mysteriously the access is gained, it implies an amount of discrimination in so minute an organism which seems scarcely conceivable.

"I have kept the *Vaucheria* gathered in February in a glass vessel to the present time (July), and although its growth has been very languid and it has lost its deep green character, it is still abounding with the capsules filled with ova and the remains of the parent. A portion of this I have brought with me; the water is peopled with *Pterodina patina*, with a few individuals of what I took for *Pleurotrocha gibba*, which was abundant in the spring.

"I feel I should apologise for occupying the time of the Club with a subject which in my ignorance appears to me so remarkable; but I could hardly resist taking advantage of the presence of Mr. Kent, who has worked so laboriously and to such excellent purpose at the life-history of these creatures, to ask his explanation of what has afforded me much interesting observation, and which, though probably well known, is, I think, not the less strange and suggestive."

Explanation of Figures.—Fig. 1. The Rotifer, distended with more or less developed eggs, removed from within a dark capsule; (*a*) red eye-spot, which appears in the young in an elongated form, concealed in fig. 4 by the gizzard; the six bright dots (*b*) are seen in the young as red granules. On the death of the creature, the dark central mass breaks up into granules in the surrounding water, with Brownian movements; the contents of the stomach, consisting of aggregated chlorophyll-granules which had before been hidden, can then be seen.

Fig. 2. An old brownish capsule from which, as well as from the stem, all chlorophyll has disappeared, the parent Rotifer being probably dead. The capsule contained more than fifty eggs, most of them enclosing young in active motion within the shell; several released young were observed crawling among the eggs and broken egg-shells, and some making their way within the tube of the stem of the *Vaucheria*, in one or two instances at a considerable distance from their birthplace.

Fig. 3. (*a*) A green capsule with two processes at the base, clearly showing that it is an abnormal growth of the fruit-bud. (*b*) Fruit of *V. racemosa*.

Fig. 4. Young Rotifer lately hatched. (*a*) Gizzard, in front of which is a ciliary disk, seen laterally; the red eye-spot is placed above the gizzard towards the dorsal surface, and between them is a group of six red granules on each side of the animal; the oral extremity is terminated by a beak-like process bending downwards above the ciliary disk. The young are active crawlers when free, but were never seen swimming.

[Dr. Cooke has pointed out to us the following note in Hassall's 'British Fresh-water Algæ' (1845), vol. i., p. 56. Speaking of *Vaucheria racemosa*, Dr. Hassall says:—"It is this species which is most frequently infested with the curious parasite, *Cyclops lupula* of Müller, which occasions the growth on the filaments of such extraordinary-looking appendages, in the midst of which the parasite resides." Dr. Cooke adds, "As I have none of Müller's works by me, I cannot say what is the modern name of his *Cyclops lupula*." See also Cooke's 'British Fresh-water Algæ' (1883), p. 125.—Ed.]

A short discussion followed, during which Mr. Saville Kent said he had a vivid recollection of encountering a record of similar phenomena with corresponding figures in one of the many English or Continental

scientific journals he had recently consulted when working out the bibliography of the Infusoria, and would endeavour to hunt up the reference for Mr. Lister. He hoped Mr. Lister would not be discouraged from the fact of the observation not being altogether original, and he had no doubt that many data of importance and interest had yet to be registered in connection with this singular phenomenon. The enigma submitted to the members by Mr. Lister as to how the Rotifers got inside the cells of the *Vaucheria*, no perforation or other means of ingress or exit being apparent in the tissues of the plant, was somewhat akin to that proposed by a certain sagacious British monarch—as to how the apples got into the dumplings. The occurrence of Rotifers, Infusoria, Rhizopods, and other lower organisms within the tissues of living plants was by no means rare, and was doubtless brought about by the invasion by the animal, in either its adult or larval condition, of the plant through some overlooked weak point, such as a decaying cell or mutilation of the adjacent tissues. The relationship of the wart-like excrescences to the enclosed Rotifer in the case of *Vaucheria* was apparently analogous to that of a gall to its contained insect, the excrescence being simply an abnormal growth of the plant-tissue produced by the local stimulus. A like interpretation, so far as he could remember, was suggested in the paper bearing upon this subject previously referred to.

Mr. W. W. Reeves, Dr. Cooke, and the President also took part in the discussion, after which Mr. Lister read a second note as follows:—

Note on the Occurrence of Carex pseudo-cyperus and the Flowering of Lemna gibba in Wanstead Park, Essex.

"On the 4th of July last (1882) I visited the grounds of Wanstead Park, which are soon to be thrown open to the public, when they may perhaps lose something of the secluded wildness which they have enjoyed for many years, and when the native fauna will at least be added to by the introduction of semi-domesticated water-fowl.

"But as yet the only change that strikes one consists in the laying down a gravel path along one margin of the lake; and it would be well worth the while of members of the Club to obtain tickets and see the locality in its hitherto undisturbed beauty.

"I came upon the lake by a narrow wood path and, cautiously emerging into the open, had the pleasure of watching at no great distance a group of some sixteen herons preening themselves in graceful attitudes upon the pathway; their dove-coloured plumage, lit up by the bright sunshine, finely set off by the dark foliage behind. A Moor-hen was sitting on its nest, raised as a little island above the water, while the thicket resounded with the song of the blackcap.

"The lake is fringed with a rank growth of *Glyceria aquatica*, at the time of my visit gemmed all over with countless numbers of slender blue Dragon-flies. The lower growth is made up of Comfrey, Greater Skull-cap, Loose-Strife, and many other marsh plants. Among the Carices, now in full ripeness are *Carex riparia* and *C. vulpina*, and the rarer species *Carex pseudo-cyperus*, a specimen of which I have brought with me.

"The 'London Catalogue' gives forty-five local districts in which it has been found in the kingdom, including the Channel Islands, but it was the first time I happened to have met with it.

"From the platform in front of the Grotto, the point which gives you the finest views of the lake and rich woods, I gathered a bunch of the *Lemna* which covers the water, and took it home, partly in the hope of finding it in flower and partly to examine the Diatomaceæ and minute life among its tangled threads. I found the older rootlets covered with *Cocconeis placentula*, but no flower of the duckweed; however, I placed the plant in a saucer of water, and on looking over it on Thursday had the great pleasure of finding *Lemna gibba* in bloom.

"Boswell-Syme, in the last edition of Sowerby's 'English Botany,' speaks of his never having discovered the flower in this species; and, as it is the rarest of the *Lemnæ*, I have some hope that its occurrence in our neighbourhood in bloom may not be uninteresting to the botanical members of the Club, and that many others may share my enjoyment by procuring specimens for themselves."

Mr. Lister's two 'notes' were illustrated by specimens and some beautiful coloured drawings of the plants referred to in all stages, executed by Miss Lister and himself. A cordial vote of thanks was accorded to him for his communications.

Mr. C. Thomas, F.R.M.S., exhibited and described a new form of "Life-slide" for the microscope, a modification of the "Hardy Vivarium," enabling it to be readily applied to observation with high powers. The following is a description of the apparatus, to illustrate which Mr. Thomas has very kindly had the accompanying woodcuts engraved by Ruffle:—

A new form of "Life-slide" ("Thomas's Vivarium").

This vivarium was devised for aiding the microscopical study *with all powers* of the Infusoria or other minute life which exist so abundantly in our ponds and ditches. Many "life-slides," "compressors," and other appliances have been used for similar purposes, but, so far as we know, none possess the advantages which are claimed for this contrivance. (1) Being composed entirely of glass and elastic bands, it is simple and inexpensive in construction; (2) for the purpose of being thoroughly cleaned after use it may be taken to pieces and put together again with ease and without the risk of breakage; (3) the object under examination may be kept alive and in a healthy state for almost any length of time, and (4) may be viewed under the highest powers that are in any case necessary or suitable for thorough examination of the most minute organisms.

The woodcuts, figs. 3 and 4, represent the vivarium of the full size suitable for use with the *large* microscope-stands of Messrs. Powell and Leland, Beck, or Ross; but, of course, it can be made of any dimensions to suit the size of the stage of the microscope employed. It is composed of two pieces of plate-glass, one of which has a circular hole in its centre (No. 1) or a segment of a circle cut out of its side (No. 2). A segment of an india-rubber ring is laid on the imperforated glass in the manner shown in the cuts, on this is placed a piece of *very* thin microscopical glass (or talc) of suitable size, then the perforated slide, the whole being firmly held together by a pair of elastic rings. We thus have a cell the upper side of which is thin enough to allow high powers to work through it, and which will hold fluid without leakage. The thin glass is so supported by the upper plate, with which it is in contact over the greater part of its surface, that there is practically no risk of breaking it in

putting the cell together. The upper (or perforated) plate is made shorter than the lower one, so as to avoid the danger of the plates being pressed together unequally, and the thin glass or talc crushed, when the apparatus is taken up by one end. A slip of thin glass can be placed inside the cell behind the piece of weed or *Conferva* bearing the organism for examination, and kept close up to the front thin-glass plate by a

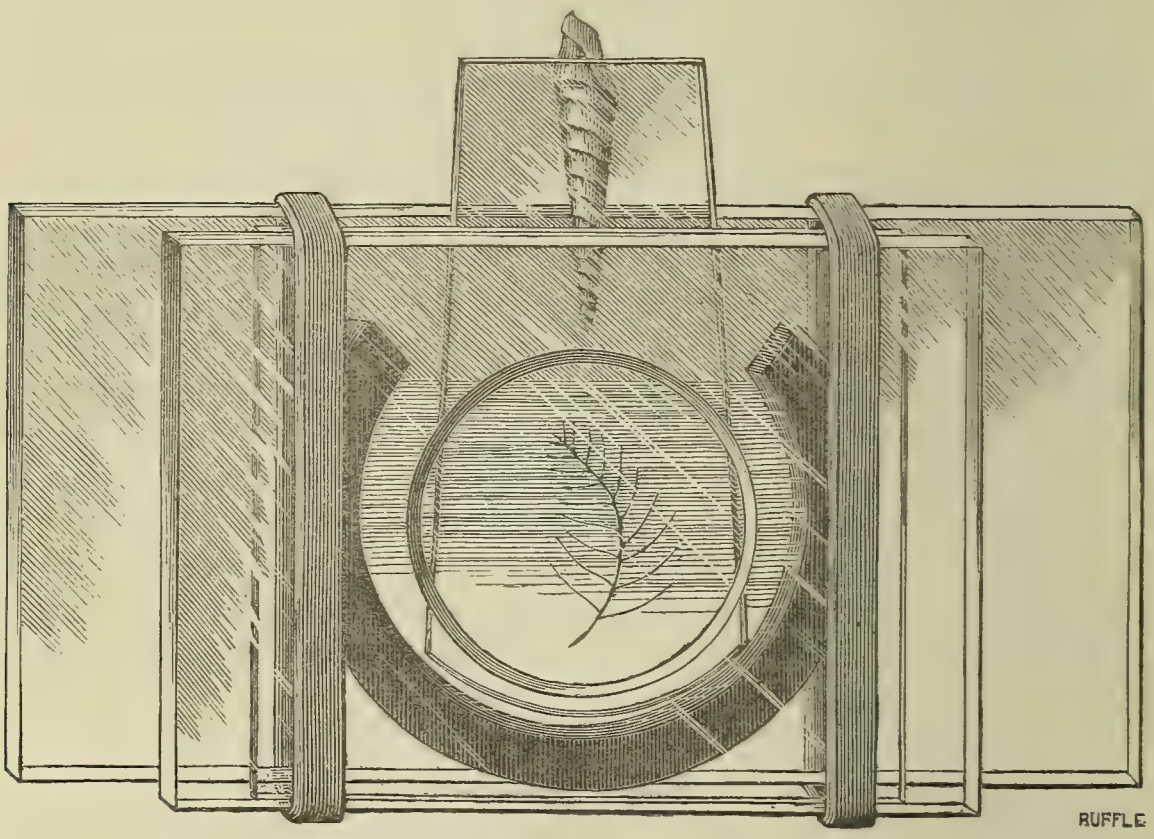


FIG. 3.—Thomas's Vivarium, No. 1.

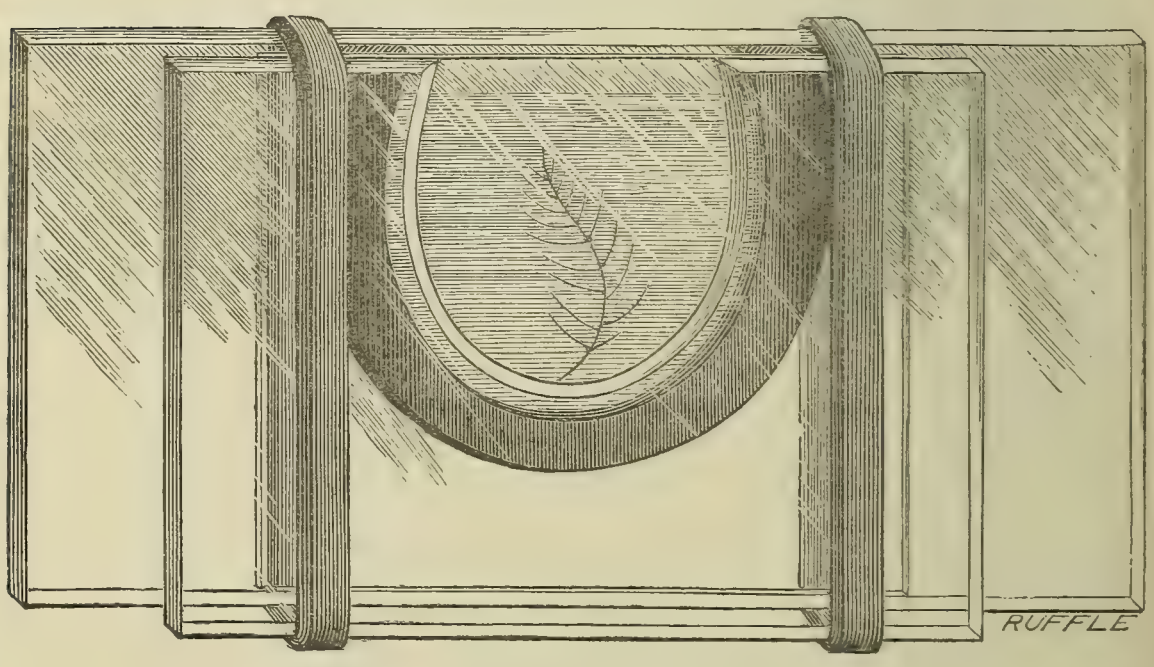


FIG. 4.—Thomas's Vivarium, No. 2.

wedge of cork or paper (as shown in No. 1), so as to bring the object within the compass of the highest powers. (See Journ. Roy. Micros. Soc., 2nd series, vol. ii., p. 688).

The President detailed the present position of the exploration of the Loughton Camp. Two cuttings had been made, but the evidence obtained was not considered sufficient, and the committee had resolved to make another cutting at least. This would be commenced shortly, and in the meantime a preliminary report would be presented to the British Association at Southampton, giving an account of the work done, and asking for a renewal of the committee, with the addition of the name of Mr. Worthington Smith, F.L.S.

Unanimous votes of thanks having been passed to Mr. Kent, Mr. Unwin, and the other gentlemen who had assisted during the afternoon, the meeting resolved itself into a conversazione, at which Mr. Oxley exhibited under his microscope *Stephanoceros eichornii* and *Floscularia cornuta;* Mr. Thomas, *Lophopus crystallinus* and *Fredericella sultana;* Mr. Letchford, *Limnias ceratophylli* and *Vorticellæ;* Mr. Saville Kent, species of Hydrachnidæ and various preparations of Zoophytes and Infusoria recently observed by him in Wales; Mr. Wire, 6 species of fossil shells from the Woolwich beds at Leyton; Mr. Fisher Unwin, various views of Chigwell and its neighbourhood; Mr. Lister, water-colour drawings of *Lemna* and *Vaucheria.* Mr. English exhibited the following species of Orchideæ, preserved by his process:—*Orchis mascula*, *O. maculata*, *O. morio*, *Habenaria bifolia*, *Ophrys apifera*, *Neottia nidus-avis* and *Listera ovata.* Also 21 species of mosses from the Forest and 4 species of *Equisetum*:—*E. maximum*, *E. arvense*, *E. palustre* and *E. limosum.*

About half-past 8 o'clock the very gratifying meeting broke up, some members driving to Woodford, others preferring to ramble through the sweet little village immortalised by Dickens, and across the water-meadows to Buckhurst Hill station.

Monday, July 4th, 1882.

This day, Sir Arthur Hobhouse, Q.C., the Arbitrator under the Epping Forest Act, attended at Old Palace Yard, Westminster, to sign the final award and official map which determines for all time the boundaries of the "free and open forest." According to this map, Epping Forest consists of 5,530 acres, 3 roods and 17 perches.*

Monday, May 29th, 1882, and following days: Monday, August 14th, 1882, and following days.

Preliminary Report on the Explorations at the Loughton Camp.

In abstracting the few literary references to Ambresbury Banks, near Copthall ('Proceedings,' vol. ii., xxx.), we incidentally referred to the

* Reduced copies of this official map, on the scale of 3 inches to a mile, may be had at Stanford's, Charing Cross, at 2*s.*, or mounted on cloth, 6*s.*; and a cheaper (incomplete) edition at 6*d.* Although not perfect, it is the best map hitherto published, and some members may be glad to know of its existence.

Loughton or "Cowper's" earthwork. Only having been recognised as a "camp" by Mr. B. H. Cowper in 1872 its written history is comprised in that gentleman's careful descriptions, no previous records being extant. The following are the titles of Mr. Cowper's papers:—(1) "Notes on an Entrenched Camp in Epping Forest, with plan by Mr. D'Oyley:" read at a meeting of the Royal Archæological Institute, November 5th, 1875 ('Archæological Journal,' vol. xxxiii., p. 88); (2) "Ancient Earthworks in Epping Forest" (*loc. cit.* p. 245); (3) 'Ancient Camps in Epping Forest, with plans by William D'Oyley, of Loughton:' a pamphlet published by the Epping Forest Fund in 1876, and now very rare; (4) "Epping Forest and its Ancient Camps" (with woodcut), 'Cassell's Family Magazine,' vol. iii. (1877), p. 153. Mr. Cowper also addressed many letters to the 'City Press,' 'Notes and Queries,' &c., in the hope of obtaining some information, but without success.

Mr. Cowper thus recounts the circumstances leading to his discovery and recognition of the camp:—

"It was on a bright summer's day in 1872 that I took a ticket to Loughton for a ramble in the Forest, which thereabouts is exceptionally attractive. After crossing a streamlet, I ascended a prominent and elevated hill commanding a prospect of remarkable beauty and extent. As I wandered on, my attention was diverted from the natural charms of this lovely spot, by what past experience suggested might be an ancient moat or ditch. A few minutes examination produced the conviction that here was one of those renowned earthworks of which examples are scattered over the country. After only a provisional investigation, and a mental resolve to make enquiry, other explorations were made, and the supposed earthwork was left, but not forgotten. . . . . During three years I could obtain no further clue, so in 1875 I decided upon seeking for the Loughton entrenchment again. I went, therefore, and this time sought the place from the Epping New Road, or from the west. I did not know the precise position, and it was only with difficulty I discovered it; in fact, not until I had mentally abandoned my task, and concluded that the camp must have been a phantom after all. It was no phantom, however, and I traced the lines of the embankment and trench for a considerable distance. This was all I could do on my second visit, except that I took note of the exact locality. Since then I have been several times, and have traced the entire circumference, and obtained other details."

Further examination, and a careful survey made in 1876 by Mr. D'Oyley, confirmed Mr. Cowper's first impressions, and to these gentlemen belong the credit of discovering and defining one of the most interesting antiquities of the kind in the neighbourhood of London. The camp is situated in the depths of the Forest, about a mile north-west of the village of Loughton, and about two miles south-west of Ambresbury Banks. It is marked on the new official map, but the dimensions there laid down are very misleading—in reality the Loughton Camp is about 800 yards in circumference, and contains between eleven and twelve acres, the two Forest camps (Ambresbury and Loughton) being almost exactly of the same size. Its position as a military station is noteworthy. It occupies the headland of an elevated plateau, overlooking the deep valley

known as "Debden Slade"* on the south, and a smaller branch valley ("Kate's Cellar") on the west and south-west. The view from the southern side is very extensive, and is bounded by the Kentish hills beyond the Thames. High Beach lies not far away to the west. The whole site is covered with forest, and a large number of very ancient holly trees grow in and around the camp. The main points of its structure are very similar to Ambresbury (see Trans., Plate III., vol. ii.), but the form is not nearly so rectangular, and the workmanship appears to be of a somewhat ruder character. The ramparts have suffered greatly from denudation, digging for foxes, sand, &c. and in one place in particular, on the western side, the bank and trench have been completely destroyed, and the soil apparently literally tumbled down the face of the hill. Near this spot also, a considerable portion of the western glacis has been removed by the Forest "improvers," to make room for their "Green-ride!" In the interior of the camp a little well or spring may be seen (artificial?) from which rises a small, sluggish stream, which gradually widens out into a *Sphagnum*-bog in a small valley, and eventually leaves the camp at the south-east corner, the embankment being there considerably worn away by denudation. A little outside the line of rampart can be detected a bank running across the bog, with a small flood-way towards the east; this has all the appearance of an ancient *dam*, by which a head of water could have been retained in the interior of the camp for the use of its inhabitants. A large number of *pits* exist in the camp, and from the head of the little valley on the west they continue round the northern part, where the ground is almost level. Some of these pits may have been made by sand or gravel digging, but many are very ancient, as their overgrown condition shows; and we are disposed to think that they belong to the original plan of the camp.† The regular circular form of many, and the distance of the site from any high road (for the Epping New Road is of course very modern), seems sufficient to negative the gravel or sand-pit theory. But we must not attempt here a complete description of the camp and its surroundings; this will be given in the full report of the investigation, with plan, map and sections, to render it intelligible.

The Club having resolved to continue the investigation of the Forest earthworks with especial reference to the Loughton Camp, the following members were appointed, at a Council Meeting held on March 25th, 1882, a Committee for that purpose:—The Officers, *ex officio*, Messrs. R. L.

* *Quære*, "Deep-den Slade," a low-lying valley in a wood; from A.S. *Denu*, a hole, cave, valley, or den, and *Slæd*, low, boggy ground.

† Just inside the rampart on the north-west corner is an immense pit, which popular traditions and old maps denominate "Dick Turpin's Cave," with some degree of probability. We know from Cauldfield's 'Memoirs of Remarkable Characters,' that the notorious highwayman did, in company with King, a congenial spirit, inhabit a "cave" in Epping Forest, at "a spot between the 'King's Oak' and the Loughton road." This cave they covered in with branches of trees, earth, &c., and, enclosed in a dense thicket of bushes and brambles, they so sheltered themselves and their two horses.

Barnes, H. A. Cole, W. D'Oyley (*Hon. Surveyor*), G. C. Harcourt, A. Lister, General Pitt-Rivers, Messrs. G. Rees, N. F. Robarts, T. Fisher Unwin, F. H. Varley, and Rev. W. Linton Wilson. At the York Meeting of the British Association (1881), General Pitt-Rivers, Mr. Meldola, and Mr. W. Cole were appointed a Committee to report upon the work, and at the Southampton Meeting (1882), the Committee was reappointed, with the addition of Mr. Worthington Smith, and a grant of £10 made towards the expenses. As detailed in the Annual Report of the Council (Appendix No. 2), a very liberal response was made to an appeal for subscriptions. A contract was again entered into with Mr. Cuthbert, of Loughton, and permission having been granted by the Epping Forest Committee of the Corporation of London, the work was begun on May 29th, and was continued day by day until June 14th, Mr. D'Oyley again acting as Hon. Surveyor, and the works being under the direction of the Hon. Secretary. Mr. W. H. Bird and Mr. C. Thomas very kindly lent levels and other instruments, and Mr. R. L. Barnes placed at the service of the explorers a very useful tent, which was a great comfort. Our member Mr. John Spiller, F.C.S., again took photographs of some of the sections.

The mode of working was similar to that employed at Ambresbury Banks (Trans. ii., 55, and Proc. ii., xxix.), and consisted in cutting sections through the rampart and ditch in order to expose the "old surface line." The soil being considerably more sandy than at Ambresbury Banks, the sieve could be freely used, and each spadeful of earth was sifted on its removal, and carefully examined for relics, the position of each object as it was found being entered on a working section of the cutting. The first section was twelve feet in width, and its cutting involved the removal of 150 cubic yards of earth. But few objects were found in this cutting. On the old surface, nearly under the centre of the rampart, two or three fragments of pottery, several flint "flakes," and pieces of charcoal were turned up. The pottery is extremely rude, and consists of badly burnt rough clay, containing quartz grains, and showing no traces of lathe turning. The great amount of denudation which this earthwork has experienced, owing to its exposed situation and the light character of the soil, has caused the complete silting up of the ditch in most parts, and it was found in this first section that the silting was so very similar in appearance to the undisturbed earth, that the form of the ditch could not be satisfactorily made out. This last circumstance, combined with the paucity of the evidence obtained, determined the extension of the investigation, and another cutting seven feet wide was commenced on June 8th. In this second section no pottery was found, but numbers of flint flakes, and a partially-finished flint celt, near the old surface line, and buried well beneath the rampart. Further evidence of human occupation in the way of charcoal and burnt clay, marking the sites of fire-places, was also found on the original surface.

General Pitt-Rivers examined the ground and objects obtained, on June 14th, but the evidence did not appear to him or to the Committee

sufficiently complete to enable any conclusive opinion being formed as to the precise age of the earthwork, although the relics thus far found, conjoined with the absence of all Roman remains, pointed to a very early, and most probably pre-Roman period. A third cutting was therefore commenced on August 14th. This was eight feet broad, and in it were found several pieces of pot, and a few flakes and "cores." The form of the fosse or ditch had previously been made out in No. 2 cutting; it was V-shaped in section—like that at Ambresbury. A fourth cutting was made longitudinally into a portion of the rampart, in which a small piece of pot and a flake were found. The last day of the week's work was devoted to several experimental diggings at one of the "pits" in the centre of the camp, and a hurried examination of some barrow-like mounds in the valley towards Loughton, pointed out to us by Mr. D'Oyley. In the pit one flint flake was found, but the "mounds" furnished no evidence of human workmanship.

As before, it is thought well to append a register of the attendances of those members of the Committee who acted as superintendents of the work of digging, at which four labourers were employed. The task was by no means a sinecure (although it was allowed to fall upon a few energetic and persevering members), as it demanded watchful care during the whole working day from 6.30 a.m. to 5 p.m. A word of praise is eminently due to our workmen, who exhibited great care and intelligence in the somewhat tedious and delicate tasks set before them :—

Monday, May 29th.—Messrs. D'Oyley, Cuthbert, B. G. Cole, H. A. Cole, and W. Cole.

Tuesday, May 30th.—Messrs. D'Oyley, N. F. Robarts, G. Rees, B. G. Cole, H. A. Cole, and W. Cole.

Wednesday, May 31st.—Messrs. G. C. Harcourt, B. G. Cole, and W. Cole.

Thursday, June 1st.—Messrs. F. H. Varley, B. G. Cole, H. A. Cole, and W. Cole.

Friday, June 2nd.—Messrs. D'Oyley, W. Cole, and Rev. W. Linton Wilson.

Saturday, June 3rd.—Messrs. D'Oyley, B. G. Cole, and W. Cole.

Monday, June 5th.—Messrs. Meldola, A. Lockyer, H. A. Cole, and W. Cole.

Tuesday, June 6th.—Too wet to work.

Wednesday, June 7th.—Messrs. Meldola and W. Cole.

Thursday, June 8th.—Messrs. Meldola, D'Oyley, H. A. Cole, and W. Cole.

Friday, June 9th.—Mr. H. A. Cole.

Saturday, June 10th.—Messrs. Meldola and W. Cole.

Monday, June 12th.—Messrs. D'Oyley, H. A. Cole, and W.Cole.

Tuesday, June 13th.—Mr. H. A. Cole.

Wednesday, June 14th. — General Pitt-Rivers, Messrs. H. A. Cole and B. G. Cole. (Inspection of the work done during the preceding thirteen days.)

The work during the week, Monday, August 14th to Saturday, August 19th, was watched by Messrs. D'Oyley, B. G. Cole, H. A. Cole, and W. Cole, no other members of the Committee putting in an appearance.

Saturday, September 9th, 1882. A Second Visit to the Dene-holes at Little Thurrock, Essex.

A meeting in Hangman's Wood was held on this day in order to explore one or two of the open holes left unvisited on June 17th ('Proceedings,' iii., xxviii.)

The Directors were Mr. Holmes, Mr. Worthington Smith, and Mr. Walker. A few members of the Club went down to Grays overnight, and others, numbering about forty, arrived by various trains during the day, which was gloriously fine. Among the visitors were Rev. Brooke Lambert, M.A., and Mr. H. W. Jackson, F.G.S., President and Secretary of the Lewisham and Blackheath Scientific Association, and Mr. S. J. Mackie, of the 'Standard' newspaper. Mr. Worthington Smith went down to Tilbury, and made a little *detour* by Mucking, Horndon-on-the-Hill and Orsett to Hangman's Wood. In a gravel-pit at Mucking, about four feet deep, he found a Palæolithic implement, with the point broken off, and several "flakes" with it. He also found several Palæolithic flakes in a gravel-pit near Orsett, the excavation being six feet deep. Both localities are *new*, and therefore well worthy of record.*

Two or three apparently open holes were examined, and found to be plugged up with boughs of trees and earth at various depths from the surface, but it was nevertheless resolved to attempt the clearance of a shaft. A promising-looking pit on the left-hand side of the woodland path (No. 3 on small map on Plate II.) was finally selected for the experiment, after several tentative descents had been made by Mr. Walker, Mr. Thomas, Mr. W. Cole, and others. Messrs. Brooks, Shoobridge, and Co., who showed the Club so much kindness on their former visit to the dene-holes, had made even completer arrangements this time to ensure the comfort of the visitors, and make the exploration a success. They had four of their men on the ground all day, and these at once set to work to remove the obstructions. The task was achieved after fully three hours' labour; shear-legs were placed over the mouth of the hole, a rope passed from a capitally-constructed box to a windlass on the bank, and the preparations were complete. The descent was a very different thing from that which was made on the 17th of June. Then, one went down at a time, either standing in a bucket, which swayed about to the alarm of the nervous, or seated upon a stick tied in a loop of the rope. The latter was the more comfortable of the two modes, but neither of them was comparable to Messrs. Brooks's box, which was even provided with a seat. Ladies, who could not make the descent before, were now enabled to do so, and during the day some of them actually did venture into the pit.

* Mr. Smith also gathered, in the stubble fields between Horndon and Orsett, many plants of the *flesh-coloured* variety of the Pimpernel or "Poor Man's Weather-glass" (*Anagallis arvensis*, var. *carnea*, Schrank), a fact which may interest our botanists.

This "Dene" proved to be a very fine specimen, and well worth the trouble taken to effect an entrance. The strata exposed in the section of the shaft were in this descending order:—Gravel, 5 ft.; Thanet sands, 53 ft.; beyond which the secondary strata of Upper Chalk were penetrated to a further depth of 22 ft., making the total depth of the entrance shaft 80 ft. Its diameter was about 3 ft., but its form was funnel-shaped at the upper part by the falling in of the sands from around the orifice at the surface, where originally the shaft was probably of no greater diameter than below. It differed from the two shafts examined on June 17th in wanting "foot-holes." At the bottom of the shaft was the usual conical mound of Thanet sand, &c., which had fallen in and trickled away in all directions. On each side were three chambers,—six in all,—arranged in a double-trefoil fashion (see Plate II., No. 3 Pit) and excavated in the white chalk, the exact horizon of the strata being clearly indicated by the thin lines of black tabular flints so well known to geologists. The chambers were tolerably uniform in length, height, and width,—height about 18 ft. and breadth about 12 or 14 ft.,—the walls perpendicular, and the roofs nicely arched and evidently made with care. In the north-west and south-east direction the extreme length from the end of the one chamber to the end of the other was about 70 ft.; in the other direction the two sets of parallel chambers were severally in similar extreme length about 46 ft. This symmetry in the arrangement and the similarity in the arched form of all the chambers is adverse to the theory which has been propounded of their having been ancient marl-pits for the application of the excavated chalk to the cultivation of the soil. The abundance of "pick-marks" (*quære*, stone, bronze, or iron) were very noticeable, the diagonal positions of which, from proper right to left on the surface, would accord with the blows of a pick, and it was suggested that the "Dene" might belong to a comparatively late period, or at least had been enlarged subsequent to its first construction. The floors of the chambers were covered to some little depth by a black humus, commingled with which were numerous fragments of soft rotten wood. Mr. Mackie pointed out that the humus was such as might well have been produced in the lapse of ages by the decay of corn or other grain, and was very like the dark soil produced by the decay of refuse malt from brewhouses. No examination of the mound of earth was possible, of course; it was estimated that a gang of men would take a week to clear it out in the careful way that must be adopted if a proper scientific examination was to be made by the Club. Only one piece of evidence was got from it, the Rev. W. Linton Wilson being fortunate enough to unearth from the lowest part of the heap a partly-worked flint. A few semi-recent bones of dog and sheep, with the gelatine still remaining in them, were turned up from the superficial sand, being those of animals which had fallen in through the open entrance.

Time did not allow of other pits being entered, and, after careful measurements had been taken by Mr. Holmes, the party walked back to

Grays, where the usual "Club tea" was excellently served at the "King's Arms" Hotel.

After tea an ORDINARY MEETING (the thirtieth) of the Club was held for the election and proposal of members, the President in the chair. The following were elected members:—Messrs. Alfred Brooks, Herbert E. Brooks, T. V. Holmes, F.G.S., M.A.I., &c., and W. Thomas.

A short discussion was initiated by Mr. Walker (Mr. Holmes being obliged to leave by an early train), who detailed the results of the day's operations. He had been very much struck with the symmetrical form of the six separate caverns, looking very like cathedral crypts, with their dome-shaped roofs, and with their careful finish as if for form's sake, showing in his opinion that these were the later dene-holes. The earliest dene-hole which we knew—that at Erith—was far ruder in construction; instead of ramifying into this complex form, there was a shaft simply expanding into a large bell-shaped chamber. Its age was fixed by its rudimentary form and by the flint implements found at the base of the cone of earth lying on the floor. The contrast of that with the hole examined that day was very marked. There, near Grays, they seemed to have got the decidedly later dene-holes, but he did not think the data were yet ripe for a full and exhaustive discussion of the subject.

Mr. Worthington Smith said he could add very little to what had been already brought forward. He really knew very little about these dene-holes. They had as yet been very superficially examined, and people were waiting for accurate information about them. His remarks on dene-holes made at the July meeting had been founded on observations upon those at Cissbury and Grimes's Graves. But evidently the dene-holes at Grays must be of later date, because it appeared they were made with iron picks, in which respect they differed very much from those of Cissbury and Grimes's Graves, which were made with the antlers of deer. It was possible, however, that the Grays dene-holes were made in very ancient times, and afterwards enlarged, and some of the closed ones might be very different in style from the others. Round the outside of these dene-holes are always found a very large quantity of flint-chips, as if the men brought the flints up and worked them round the edges of the pits. But till they had these pits really worked, and saw whether the men went down to the bed of flints and then stopped, they could say nothing about them. The dene-holes should be carefully surveyed, and every hole stopped or unstopped marked on a plan, with the levels. Then an exploration should be made of as many as possible, and sections prepared showing the measurements of each. Part of the *original floor* of the pits should be uncovered. There might be "hut-circles" near, and the ground around for three or four miles should be carefully examined. Until this was done, in his opinion no decided verdict could be pronounced upon them.

The President remarked that, seeing the success which had crowned their efforts in other researches in pre-historic archæology, he had no

doubt that an appeal to their members would place them in possession of the funds necessary to undertake a thorough investigation of these remarkable vestiges of ancient life in Essex.

Mr. Mackie, who was requested to speak, said he should have been very pleased to be able to contribute any information on the subject of these deep dene-holes. Although he believed they were almost exclusively confined to Kent and Essex, that was the first time that he had actually examined one of them, and he could not, therefore, speak with any authority upon their nature or origin. They struck him as being exceedingly curious, and he was glad to hear the remark of Mr. Worthington Smith that the one they had examined had possibly been enlarged, because he had detected so great a number of pick-marks. He impressed upon the Club the necessity of proceeding in a systematic manner with any examination that might be made, and declared that in Kent and Yorkshire and many other places the examinations of barrows and other antique burials had been simply nothing less than desecrations. [Hear, hear.] They had not served a proper scientific purpose; it was not enough to take away the skulls and a few ornaments—it was essential to learn something of the status of the men and women of the time. He then described an investigation which had been made in a cave in Yorkshire, where they removed six inches of earth at a time, and marked every relic upon a plan in its proper position. The result was that they were able to tell the story of that cave completely. It had been inhabited by a man, his wife, and their three sons, who were engaged in bronze-casting, and had been overwhelmed by a flood. These facts could not have been discovered but for the care which had been used. In these dene-holes he advised that, in the absence of any great number of relics, very great care should be taken to go down step by step. He added that it had struck him that there was a very considerable quantity of humus in the soil; if this proved to be so, it would suggest the question whether these dene-holes had not been used as stores for grain.

The Rev. Brooke Lambert, President of the Lewisham and Blackheath Scientific Association, remarked that in various parts of Blackheath sudden subsidences of ground had been noticed, and on one particular occasion a piece of ground nine feet in diameter fell suddenly fourteen feet in one night. There were many speculations as to the cause of this fall. Mr. Holmes was very decidedly of opinion that they had come upon a dene-hole there, as one was known to exist at Eltham.* They determined to investigate it; they dug down forty-two feet, and then bored another forty-two feet. But the whole energy of Mr. Jackson and his friends could not produce more than two hundred pounds for the work, and, as they came upon rock too hard for their tools, they were obliged to leave the work undone. They put up a stone on the spot

* See 'Report of the Committee for the Exploration of the Subsidences on Blackheath,' with plate of sections and plans by Mr. Holmes, published by the Lewisham and Blackheath Scientific Association (1881).

recording their work and their failure, but not adopting the inscription which he had suggested. He had suggested that they should use the epitaph upon a baby's tombstone :—

"If so early I was done for,
What on earth was I begun for ?"

[Laughter.] He thanked the organisers of that expedition for the very admirable way in which all had been managed.

Mr. Worthington Smith, in reply to Mr. White, who asked for information respecting some holes existing in a wood near Cromer, Norfolk, supposed to be about 2000 in number, said that Mr. Spurrell had investigated them, and had discovered that they were not at all like the Essex or Kent dene-holes, but were very shallow excavations, and appeared to be ancient pit-dwellings. A considerable quantity of iron ore had been found in them, which led to the supposition that they had been the habitations of people living in the early iron age.

The President asked the Society to return its thanks to the conductors, which was done by acclamation. Thanks were also voted to Messrs. Brooks, Shoobridge, and Co. for the great facilities they had provided for the descent into the holes, and Mr. Walker, on behalf of the conductors, thanked Mr. W. Cole, the Hon. Secretary, for the care which had been shown in planning and carrying out all the arrangements.*

* The two visits made by the Club to the Hangman's Wood dene-holes attracted considerable attention, and an admirable report of the last visit was given in the 'Standard for September 11th, followed by many letters and articles in the same paper, in the 'Times,' 'Daily Telegraph,' 'Notes and Queries,' &c., &c., but few of which added anything to the information given above. It may be well, however, to quote the following remarks by Mr. Spurrell in a letter to the 'Standard,' dated October 4th :—"Some of the caverns, and presumably the oldest, were dug by persons (I think for flint, and as dwellings) who did not use metal in the work, but must have employed no better tools than wood or bone; whilst other evidence places their origin as far back as the pure stone (Neolithic) age; and this, too, in the case of the Hangman's Wood holes. In later times similar excavations were made for the same and other uses, such as are discussed by me in a paper published in the 'Archæological Journal' of this year. It is not surprising that those who see but a few instances, and those in populous districts, should be puzzled by them. Even the late Mr. Darwin connected their formation, as he several times remarked to me, with the chemical action of rain on chalk, aided by worms (see his work, 'The Formation of Vegetable Mould through the action of Worms'), for he thought that the worms by their burrows directed the carbonic and humic acids in such a way into irregularities of the chalk—of his neighbourhood—as to cause the pipes and pits he describes. The periodical falling in of holes at Down is to be ascribed to dene-holes, I know, and also that there are no pot-holes in such active condition there as he describes, I know also. During the late agitation concerning the subsidences on Blackheath, much promoted by the late Astronomer-Royal, Sir R. Airy, the local Natural History Societies of Blackheath and Lewisham frequently discussed the matter, and cases were made out for many different natural causes, but I have had no difficulty for many years in connecting the subsidences with the existence of dene-holes there formerly, as in other places. However, much has to be done in excavating, and I hope that the members of the Essex Field Club will be well supported in their very nteresting examinations underground."

SATURDAY, SEPTEMBER 23RD, 1882.—ANNUAL CRYPTOGAMIC MEETING.

The third annual gathering of the cryptogamic clans in Epping Forest was fixed a week earlier than before, in the hope of obtaining some species not observed at previous meetings. The day was extremely fine, but Fungi were not abundant, the weather having been very unfavourable during the previous week or ten days. The following botanists kindly acted as directors and referees :—*For Fungi*, Dr. M. C. Cooke, Rev. Canon Du Port, M.A., Mr. English, Mr. C. B. Plowright, M.R.C.S., Dr. Spurrell, Mr. Worthington G. Smith, and Dr. H. T. Wharton, M.A., F.Z.S. *For Mosses*, *Lichens*, and *Phanerogams*, Professor Boulger, F.L.S., Rev. James Crombie, F.L.S., Mr. F. J. Hanbury, F.L.S., Mr. E. M. Holmes, F.L.S., and Mr. W. W. Reeves, F.R.M.S. The attendance of members and friends was very large, nearly 100 persons being present, including many well-known naturalists.

A very considerable number of species of Fungi were collected and identified, although the individual specimens were not plentiful, and were often in bad condition. Notwithstanding this the exertions of our experts resulted in the addition of no less than twenty-two species to the Epping Forest list of Hymenomycetes ('Transactions,' vol. ii., pp. 181—191), not including three or four, which could not be with certainty determined at the meeting. The most interesting species belonged to the genus *Cortinarius*, a peculiarly difficult one, as all mycologists know (*Cortinarius* (*Hydrocybe*) *renidens*, Fr.). This was found by Dr. Cooke at High Beach, and it is a remarkably distinct species, never before gathered in Great Britain ('Grevillea' for December, 1882). It is scarce even in Scandinavia, where only it has hitherto been found.* It is unnecessary to name all the species observed, as the bulk of the characteristic Forest species are recorded in the reports of previous meetings (see 'Proceedings,' vol. i., p. xlviii., and vol. ii., pp. lx. and lxxxiii.) Mr. English found *Agaricus rugosus*, *A. inopus*, *Boletus parasiticus*, and *B. badius* in Monk Wood, all new to the Forest. Canon Du Port, after referring to the difficulty of identifying some of the species, says :—"Two species that were new to me are, in my opinion, satisfactorily determined : (1) *Agaricus* (*Trich.*) *stans*, with a dirty-tawny or yellowish-umber, viscid top, solid stem, and flesh-coloured under the cuticle, turning slightly red when cut and exposed to the air ; (2) *Russula sanguinea*, with decurrent gills. It is described in Dr. Cooke's 'Handbook,' but is rare. I found also *Agaricus spissus*, a very well-marked species, the top greyish, with small, close-set, evanescent, mealy warts. Everybody saw the beautiful *Agaricus mucidus* on the Beech trees, and a somewhat deformed plant *may* be *A.* (*Trich.*) *portentosus*, but another season must come before it can be settled. I have satisfied myself that the form of *A.* (*Collybia*) *dryophilus* which we found

* A list of thirty-six *new* Epping Forest Fungi, discovered in 1882, was subsequently communicated to the meeting of the Club on November 25th, 1882 (*vide* Report of that meeting, *infra*). It, of course, includes the species to which reference is made above.

was *funicularis*, but I have forgotten to mention this to my friends. I noticed *A.* (*Pleurotus*) *spongiosus*, a species well marked by being softer than its congeners. A *Flammula* was found, which I should be disposed to call *A.* (*Flam.*) *alnicola;* Mr. Plowright, however, inclined to *A.* (*Flam.*) *inopus* as the rightful name. I found a great mass of *Lactarius quietus*. *Russula fellea*, with pileus and stem both straw-coloured, and *Russula ochroleuca*, with stem cinereous, are both well-marked species. As I walked to the station we passed several places near the 'Loughton Camp' where charcoal had been burnt: these are often good places for fungus hunting; in fact the whole of the ground in the hollow beneath the Camp [Debden Slade, &c.] looked to me very promising." Some pigs were espied busily turning the ground under the Beeches with their snouts, and Mr. English had the curiosity to examine their workings. Piggy had overlooked in his eagerness one specimen of *Elaphomyces granulatus*, an interesting truffle-like tuber, and the clue being thus afforded, Mr. Plowright speedily found plenty of examples by a little persevering raking up of the soil.

Mr. E. M. Holmes, F.L.S., noticed several species of Mosses, by far the most noteworthy being *Zygodon forsteri*. In the 'Journal of Botany' for November, 1882, Mr. Holmes gave the following account of this important resuscitation of a long-lost species, which we extract by kind permission of the author:—

Zygodon Forsteri, Mitten, in Essex.

"On the occasion of the Annual Fungus Foray in Epping Forest, on the 23rd of September, 1882, I met with this rare moss in fructification; and, as its occurrence in Essex has hitherto been only conjectural, its rediscovery in that county seems worthy of record.

"In Wilson's 'Bryologia Brit.,' p. 194, Walthamstow and Sussex are mentioned as two localities in which it had been found. A much more correct account might have been given had Mr. Wilson not ignored Mr. Mitten's remarks, published four years previously, in the 'Annals and Magazine of Natural History' for 1851 (2nd series, viii., 322).

"The history of the discovery of this plant in Britain I believe to be as follows:—Mr. T. F. Forster found a specimen of the plant on *a felled tree in a timber yard* at Chapel End Lane, Walthamstow, there being no record where the tree was obtained. The specimens gathered by him were distributed to Dickson, Borrer, Sir J. E. Smith, and others. One of these occurs in Dickson's Herbarium, and another among the original specimens used for 'English Botany,' both of which collections are in the Botanical Department of the British Museum; but neither of these specimens bears any date on the label. A third specimen exists in Mr. Borrer's Herbarium at Kew. The plant must, however, have been collected previously to 1794, as Dickson's 'Fasciculi' were published in that year. There are no specimens of the plant in Wilson's Herbarium (also in the British Museum) nor in that of Mr. Jenner, now in the possession of Mr. C. P. Smith, of Brighton. That gentleman informs me that Jenner's plant was identified by Mr. Mitten. Mr. Mitten kindly referred me to his paper, above cited, and tells me that Mr. Jenner gathered the moss during an extended ramble, but whether in Sussex, Hampshire, Kent, or Surrey, it could only be conjectured, as the large

packet of mosses among which the specimen was detected by Mr. Mitten bore no label, and the only clue to the locality where it was gathered lay in the fact that the *Zygodon forsteri* was wrapped in a billhead with a Hastings address upon it.

"Until a few years ago, therefore, when Miss I. Gifford found the plant at Minehead, no exact locality was known in Britain for this species. In the locality pointed out to me by that lady the moss grew on the top of an old stump behind a gate in a field, and bore some resemblance to a *Pottia*, for which it was at first mistaken by Miss Gifford, being subsequently recognised by Mr. H. Boswell, of Oxford, to whom she sent it.

"I found the moss in Epping Forest on the root of an old tree where water collects in little depressions among the roots. It seems to prefer damp timber; in size and habit of growth it resembles *Tortula muralis*, for which it might easily be mistaken if the short seta and furrowed capsule were not noticed. Neither at Minehead nor in Epping Forest did I see more than a single patch, so that it does not appear to be a gregarious species like *Z. viridissimus* and *Z. conoideus*. The leaves in the moist state are remarkable for their rigid, dark green, succulent appearance. On the Continent also this plant appears to be a rare southern species. It has been found growing on the poplar, cork, oak, holly, and elm. I did not notice on what tree it occurred in Epping Forest, but believed to have been beech."

With one exception the phanerogamous plants observed do not call for special notice, that exception being, curiously enough, also a re-discovery. Near the railway station at Woodford Mr. W. W. Reeves met with a plant of *Senecio viscosus*, L., a very local and generally a rare species. It was recorded in 1771 for Woodford in Warner's 'Plantæ Woodfordienses' as the "Cotton Groundsel or Strong-scented Groundsel, in sandy ground; not uncommon." Edward Forster in his paper, "Corrections of erroneous habitats given to British Plants" ('Phytologist' ii. 611), says this was "a blunder of Warner's; not to be found at or near Woodford." Gibson, in his 'Flora of Essex,' only gives one station for it, "Syme's Farm, near Epping," and adds "a state of *S. sylvaticus* was probably the plant meant by Warner and others." Mr. Reeves's specimen was without any doubt correctly named, having been submitted to the Kew authorities. It was particularly interesting to find the plant, after having been lost and doubted for over a century, still growing near the spot where possibly it was first gathered by Warner.

Many of our microscopists were actively engaged in "pond-hunting" during the day, but in the absence of any detailed reports it may be interesting to append a list of Infusoria met with by Mr. Saville Kent at the previous "Foray" (October 1st, 1881), which unfortunately escaped record at the time. The species were found in association with *Myriophyllum* (Water-Milfoil) in ponds on the Epping New Road:—

Flagellata.—*Codosiga botrytis*, Ehr., *Salpingæca amphoridium*, J.-Clk., *Dendromonas virgaria*, Weisse, *Anthrophysa vegetans*, Müll.

Cilio-Flagellata.—*Peridinium tabulatum*, Ehr.

Ciliata.—*Vorticella nebulifera*, Ehr., *V. campanula*, Ehr., *Vaginicola crystallina*, Ehr., *Halteria grandinella*, Müll., *Stentor polymorphus*, Müll., *Cothurnia imberbis*, Ehr., *Ophrydium sessile*, S. K., rare; this species was

first distinguished from *O. eichornii*, Ehr., by Mr. Kent in November, 1871, specimens reaching him from Stourbridge, Worcestershire ('Manual of the Infusoria,' 738). He goes on to say:—"Quite recently, October, 1881, the author has obtained luxuriant colonies of this species attached to *Myriophyllum* growing in a pond in Epping Forest, visited in connection with a field-day of the Essex Field Club. It was observed of examples preserved for some days that the zooids freely abandoned their original mucilaginous zoocytium, and, reattaching themselves independently, were scarcely distinguishable during such isolated condition from those of *Gerda fixa*, D'Udk." *Stichotricha secunda*, Perty. (rare), *Litonotus fasciola*, Ehr., with plenty of *Chilodon cucullulus*, Müll. Most of the species were in abundance.

In Monk Wood, Mr. Henry Corder noticed a peculiar gall-like formation on the leaves of the Wood-Violet (*Viola sylvatica*), and the same were afterwards found in abundance by Mr. W. Cole. The leaves of the plant are curled, thickened and folded over, taking a purplish hue, and forming little chambers which sometimes contain a small orange-coloured larva. Specimens were afterwards submitted to Mr. E. A. Fitch, F.L.S., who is of opinion that they are the work of a Gall-gnat (*Cecidomyia*) hitherto unrecognised in Britain. Mr. Fitch has favoured us with the following note:—

CECIDOMYIA VIOLÆ, F. LÖW, IN ESSEX.

I have examined the supposed galls sent me by Mr. Corder and Mr. Cole. From the first specimens received I thought they were only abortive cleistogamic flowers of the Violet (*Viola sylvatica*), but from the later specimens I have the orange cecidomideous larvæ in some numbers, proving them to be pseudo-galls and the work of gall-gnats. I have but little doubt that they are the work of *Cecidomyia violæ*, a species only described last year (1881) by Dr. Franz Löw, although his galls occurred on *Viola tricolor*, and these are on *V. sylvatica*. After fully describing the male and female gall-gnats, Dr. Löw proceeds as follows:—

"The larvæ of this gall-gnat are pale orange-red; their third and fourth segments are darker orange-red. They live in numbers in rosette-like leaf-galls on *Viola tricolor*, and pupate therein in white cocoons. These leaf-rosettes occur at the tips of the stalks and on the side-shoots which originate at the axis of the stalk; by the action of the gnat-larvæ the internodes become greatly shortened, thickened, and altered in different ways, so that the leaves become crowded closely together. The adjacent leaves are affected as follows: they remain very short, are not so deeply cleft as the normal ones, are somewhat thickened and rolled inwardly towards the upper side from both edges in the shape of a cornet, and are covered with a very rich growth of hair. Flowers on a very short, thick, twisted stalk, and which do not become fully developed, usually occur between the leaves. In such flowers the calyx is generally malformed like the above-mentioned leaves, the petals are generally green and deformed, and the organs of fructification wholly or partially abortive. This gall has hitherto only been observed in the months of July, August, and September, at which time the gall-gnats emerge. I first found it in 1878 in great numbers at Payerbach, in Lower Austria, in a fallow field, and since then at Baden in a stubble. Herr Alfred Hetschko sent it me at the end of August, 1879, from Ellgoth, near Teschen, in Austrian Silesia, and, according to a short note from Herr D. H. R. v. Sehlechtendal, he also finds it at Zwickan, in Saxony."—('Verhandlungen der k.-k. Zoologisch-botanischen Gesellschaft in Wien,' vol. xxx., p. 35, 1881).

After the researches of the afternoon, the large party returned to Loughton, where tea was served at the "Crown" Hotel. The specimens collected during the day were arranged in one of the rooms of the inn, and were named by Dr. Cooke, Mr. Smith, and the other experts.

The evening meeting commenced with a recital by Dr. Cooke and Dr. Spurrell of some of the mycological observations of the day, which have been embodied in the preceding account. Mr. Holmes alluded to the rediscovery of "Forster's Moss," already recorded.

The Rev. J. M. Crombie, as recorder of the Lichenes, remarked that he had found Monk Wood very destitute of lichen-life. Hornbeam and Beech were by no means favourable to the development of lichens. Some years ago, in arranging the lichens in the herbarium of the British Museum, he had come upon the collection made by Edward Forster, and it was quite evident that forty-five years ago Epping Forest was remarkably rich in lichens. His (Mr. Crombie's) own list, made twelve or fourteen years ago, comprehended some sixty species and varieties, and the collection made by Forster certainly amounted to three hundred varieties and species. There was, therefore, no doubt that a very considerable change had taken place.*

Mr. E. M. Holmes then read the following paper, which was illustrated by some admirable coloured diagrams specially prepared for the occasion by Mrs. Holmes, and by a large number of specimens and preparations :—

Notes on the Study of Marine Algæ.

"That a Natural-History Society should embrace all branches of botanical science among its subjects for investigation, and that therefore Marine Algæ should not be neglected, must be my apology for bringing such a subject before an inland meeting. Marine Algæ have probably received less attention from British botanists during the last thirty years than any other class of plants, but if one may judge from the number of interesting and important discoveries that have been made on the Continent concerning their modes of growth and fructification during the same period, no class of plants would better repay careful investigation. Although the old classification of Marine Algæ into Green-, Red-, and Brown-spored Algæ is known to be incorrect and unsatisfactory, the present state of our knowledge of the development of many species is too incomplete to permit of a new one being devised. Such knowledge can only be obtained by residence near the sea, and this is possible only to a few.

"Those members of the Essex Field Club who have the opportunity of occasionally visiting the shore may render good service to British algology by collecting and recording the species to be met with on the coast of Essex. The British marine flora is by no means exhausted, for although about thirty† new species have been detected during the last two years, chiefly in Dorset, Devon, Cornwall, and Fifeshire, there are still many continental species occurring on the French and Norwegian coasts which are almost sure to be detected on the British shores if

* Mr. Crombie has given the results of his observations on the past and present condition of the *Lichen*-Flora of Epping Forest in a paper read before the Club on April 28th, 1883, which will appear in a future part of the 'Transactions.'

† This number has now (June, 1883) increased to sixty.

careful search is made for them. I speak with confidence on this point, having recently found several of them. These Algæ are probably brought to our shores by the ocean currents. Judging from the character of the species occurring on our coasts, I have been led to the conclusion that the warm water of the Gulf Stream brings southern weeds, including some Mediterranean species, to our southern and western shores, its influence extending as far as Folkestone to the east and the Orkneys to the north. In the opposite direction a cold current, bringing with it northern species, appears to descend from the north, and probably sinks beneath the warm water from the south when it meets it, both currents leaving Algæ to settle and grow wherever there occurs a quiet land-locked bay into which they can be carried by an eddy. The cold current, apparently divided by the north of Scotland, seems to pass down both sides of England, being probably diverted from its course by the projecting land of Wales on the west and Norfolk on the east. At least, I have not been able to trace such northern species as *Odonthalia* further south than Yorkshire, nor such southern ones as *Cystoseira ericoides* further north than Anglesea. This theory seems to be corroborated by the fact that several southern species of Lichens have been found on the coast of Anglesea, while the Foraminifera of the north-east of Britain have been found by Mr. H. B. Brady, F.R.S., to be identical with those of Norway. Having traced the northern Algæ as far as the Wash, and the southern as far as Folkestone, it would be especially interesting to ascertain the character of those found on the Essex coast on the east and of the Welsh coast on the west, but of the Algæ of these coasts there exist, I believe, very meagre records. That an investigation of the marine flora of Essex would prove very interesting I have but little doubt. While looking through the herbarium of the late Dr. Landsborough I came across a specimen of a North American seaweed, *Dasya elegans*, labelled 'Thames River, February,' but whether it was found on the Essex coast or not was not mentioned. The plants of this genus love muddy shores, and as this species is found also in the Mediterranean the question arises, is it a native of Britain, or was it merely brought here attached to a vessel which had remained some months in a foreign part? This question an investigation of the Marine Algæ of Essex might settle. Almost the only other contribution I can offer to the Essex list of Marine Algæ is *Bostrychia scorpioides*, an amphibious species occurring on the roots of *Obione pedunculata* and other seaside plants, sometimes, as near the Isle of Portland, covering extensive pieces of ground. A specimen of this plant I observed in the herbarium of the British Museum from Maldon, Essex. Although the plant occurs so abundantly, I am not aware that the capsular fruit has ever been found in this country.*

"It may be useful, perhaps, to call attention to those groups of Algæ in which new British species are most likely to be discovered on Essex shores. On a comparison of the French flora with the English the principal genera which are less fully represented in this country appear to be *Lyngbya*, *Oscillaria*, *Cladophora*, *Callithamnion*, *Polysiphonia*, *Ectocarpus*, and *Mesogloia*.

"Of these genera I propose to give a brief sketch, such as may enable anyone unacquainted with our English species to know where to look for them, and to refer the plants to their respective genera when found.

"There are probably few persons who have botanised along muddy creeks who have not noticed scattered here and there small patches having the appearance of dark green or bluish green slime, sometimes floating on marine plants and sometimes growing on the mud. If a

* Some ripe capsules have been detected by Mr. Buffham, since this paper was written, on specimens brought by me from Portland.

little of this be brought home and placed on a piece of moistened paper, in a few hours a brilliant bluish green colour will be found to have spread around the central patch. This is due to the fact that the simple unbranched threads, each of which constitutes a plant, have the power of moving in an oscillating manner, and have thus crept along the paper free from the attached mud. From this peculiarity the plants of this genus receive the name of *Oscillaria*. The group to which it belongs is also characterised by the possession of a bluish colouring matter, and are hence called Cyanophyceæ. This colouring matter exhibits a reddish tinge when viewed by reflected light. Through the kindness of Mr. H. C. Sorby, F.R.S., who has paid considerable attention to the colouring matter of plants, I am able to lay a specimen of this substance before you. Two or three other genera, also belonging to the Cyanophyceæ, might also be looked for. Of these *Lyngbya* differs from the above chiefly in the plants not having the power of locomotion. *Spirulina* differs from *Oscillaria* in the threads being twisted like a corkscrew. *Beggiatoa* is remarkable in this group for the absence of colour, for growing on decaying Algæ where hydrogen sulphide is given off, and for the presence of granules of *sulphur* in its fronds. No species of this genus has been recorded as British, although *B. lanugo* is almost sure to be found if carefully searched for, forming a white fringe on the fronds of *Ceramium rubrum*. So far as is known the plants of these genera are propagated only by the separation of the contents of the threads into portions, each of which can, after leaving the parent frond, develop into a new plant.

"Near high-water mark a number of green, grass-like Algæ are sure to attract attention, either floating in the pool or attached to rocks or stones. On gathering some of these it will be observed that some of the threads are branched and others not so; that some taper towards the tips, while others taper towards the base. Those that are unbranched, taper towards the base, and consist of a single series of cells, belong to the genus *Chætomorpha*, *i.e.*, bristle-shaped Algæ; while those that are branched, and whose threads consist of a single series of cells, belong to *Cladophora*, *i.e.*, branch-bearers. In both these genera the contents of distinct cells become metamorphosed into two kinds of zoospores, *i.e.*, living spores, so called because by means of cilia they are enabled to move through the water, like Infusoria, from which indeed it is difficult sometimes to distinguish them except by their power of becoming attached and germinating. The larger zoospores have generally four and the smaller two cilia. These are believed to coalesce before germination. The genus *Enteromorpha* often resembles *Cladophora* in habit, but under the microscope the branches are seen to be composed of a number of minute rounded cells irregularly arranged.

"The genus *Ectocarpus* resembles *Cladophora* in consisting of branched threads, composed of a single series of cells, but differs in having a brown colour, and in the character of the reproductive organs. These are of two forms: the one globular, the simple cavity of which contains a number of small zoospores; the other more or less pod-shaped, divided into a number of compartments, each of which contains a single large zoospore. Both kinds of zoospores have only two cilia. The plants of this genus are mostly parasitic on larger Algæ, and look like tufts of brownish wool when in the water.

"The genus *Mesogloia* comprises a group of brown Algæ that are easily recognised by their gelatinous, slippery fronds of complex structure. Most of the species not found as yet in England grow on the roots or old leaves of *Zostera*.

"The species of the genus *Callithamnion* also resemble those of

Cladophora in structure, but are of a red or pink colour, and have much more highly developed reproductive organs. These consist of an organ resembling the pistil of flowering plants, which is fertilised by antheridia, and subsequently results in a double mass of spores enclosed in a thin membrane. The antheridia occur in rounded tufts, taking the place of a branchlet. Besides these organs some of the branchlets are replaced by oval bodies called tetraspores, and which may be considered analogous to the deciduous buds of flowering plants and ferns, since they can reproduce the species without fertilisation. There are three forms of tetraspores in different genera of the Red Algæ, but in the *Callithamnia* they are usually tripartite or cruciate. The plants of this genus form small pink tufts on other Algæ, or grow on mud or on the muddy sides of quays at very low water.

"The *Polysiphonia* differs from the *Callithamnia* in the threads of the fronds being compound, each joint containing four or more tubes or siphons. The female flower, if it may be so called, results after fertilisation in a capsule containing a number of spores, and the colourless antheridia are sausage-shaped and attached to the tips of the fronds, giving them a yellowish appearance. The tetraspores are formed inside the terminal branchlets. These plants are found chiefly on rocks and stones or muddy shores, and some of the species are of very limited duration.

"In conclusion, I may add that the most likely places to prove prolific in new British species are brackish ditches near the sea, mill-pools containing sea water, estuaries, muddy and sandy creeks where the water flows in slowly, and *Zostera* beds. Shells and larger Algæ brought up by the dredge are also worth examination. Of many microscopical species the life history is very imperfectly known, and would well repay careful study. The influence of sex, of fresh water, and of rough and still water in controlling the shape and appearance of Marine Algæ are points that require further investigation."

Mr. C. B. Plowright, M.R.C.S., of King's Lynn, gave (*vivâ voce*) a highly graphic and amusing summary of his recent researches upon the reproduction of the Uredines, a group of Fungi, comprising the rusts and mildews of cereals, which furnish some of the most striking illustrations of the phenomena of "cyclical propagation" among plants. Mr. Plowright confined himself to the history of the development of the corn-mildew or "rust" (*Puccinia graminis*), tracing its connection with the Barberry Fungus (*Æcidium berberidis*), illustrating the subject with some clearly-drawn diagrams and specimens. Mr. Plowright's remarks will not bear condensation, but his valuable results will be found recorded, together with a history of the literature of the theory of heteræcism in this group of Fungi, in his various papers in 'Grevillea,' 'Gardeners' Chronicle,' 'Science Gossip,' and the 'Transactions of the Woolhope Club' during the years 1881 and 1882. All these papers may be consulted in the Library of the Club, and the whole subject possesses great interest to dwellers in the country having microscopes, and endowed with the skill and perseverance necessary to follow in Mr. Plowright's footsteps.

Mr. Worthington G. Smith, F.L.S., then read the following paper,

in illustration of which he has most kindly drawn and engraved the two accompanying woodcuts:—

On Fairy Rings.

"Every person who has walked in the summer over grassy hills and through fields and woods must have noticed fairy rings. Sometimes they present themselves as circles and curves of bare ground, at other times the barren circle of ground has a rim of luxuriant grass outside; in some instances this circle or curve of dark rank grass has a third circle of Fungi beyond its outer line. In a perfect fairy circle we have, then, starting from the centre, a ring of barren ground, a ring of rank grass, and a ring of Fungi. In some instances a fairy circle of Fungi is only to be seen. Circles, curves, and quadrangles of rank grass and Fungi are sometimes seen that are not fairy rings, and it will, perhaps, be better to mention and dismiss these spurious rings and other geometrical forms at once. For instance, any one who has walked in open places in plantations must have frequently observed a ring of Fungi encircling a tree, at a line on the ground indicated by the spread of the branches above. These growths are especially common in fir plantations. Something drips from the tree, some resinous or other substance that favours the growth of certain Fungi, and they come up in an irregular ring at the drip of the tree where this substance has fallen. Such a ring is not a true fairy ring, and such a ring can never extend itself beyond the drip of the tree. Similar spurious rings and sometimes quadrangles may at times be seen around old hay and corn stacks, and even barns, at the place where moisture and decayed vegetable material has dripped from the overhanging edge. Such lines of rank grass and Fungi have nothing whatever to do with fairy rings. Sometimes an old horse may be tethered to a stake, and as he walks round and round his hoofs may wear away the grass and make a circle of barren ground; but such a circle is not a fairy ring. In some places where moles disturb the ground, such disturbed ground is found occasionally to bear a crop of Fungi, but a crop of Fungi on a mole's run, whether curved or not, is not a fairy ring. Fairy rings, then, are not caused by hay-cocks, tethered animals, the drippings of trees and barns, circular fertilising exhalations from the earth, or electricity. That they are not caused by hay-cocks is proved by the frequency of true fairy rings on lawns opposite to the drawing-room windows, where hay-cocks are not allowed to ornament the scene. If one walks on the edges of the cliffs on the South Coast numerous true fairy rings and semi-circles will be seen, the centre frequently on the very verge of the cliff, and the semi-circle inland. Such semi-circles prove that tethered animals do not cause fairy rings, for no owner of an animal would be such a lunatic as to drive a stake into the very edge of the chalk cliff, as at Beachy Head, and there tie his animal to it. Besides some fairy rings are only six inches across, and what quadruped or insect could be tethered to make such a ring? That moles do not cause fairy rings is proved by the presence of the ring where moles are unknown, and on expanses of rock only covered by an inch or two of humus where moles cannot exist, and never have existed. Circular exhalations from the earth where fairy rings abound must, I think, be very rare, for I have seen thousands of fairy rings, but I have never seen a circular terrestrial fertilising exhalation! Electricity is not a speciality of mine, but as I know fairy rings to be invariably caused by something else it follows that they cannot be caused by electricity. As for the rings being caused by the tripping feet

of fairies in a circling dance, few people now, unfortunately, believe in fairies. They have gone the way of the giants, dryads, gnomes, and wraiths, since

'In Briton's isle in Arthur's days,
The mid-night fairies danced the maze.'

We could ill spare any of them, but in these times, when even the very youngest men are teaching us about the origin and evolution of all the phenomena of Nature, there is scant room for the fairies. The best known fungus occupant of fairy rings is the Fairy Ring Agaric, or Champignon, *Marasmius oreades*, termed in the older botanical books *Agaricus oreades*. It was termed *Marasmius* from the habit possessed by all the species of drying up and shrivelling in decay, as distinguished from Agarics proper, which all speedily putrefy. It has derived its name of *oreades* from the Oreads, the playful nymphs of the hills and mountains. The Oreads were the companions of Pan or Hylæos, the forest god, and they danced and circled to his piping. The feeling of loneliness belonging to hilly places was attributed to the presence of Pan, and from this old belief has arisen our modern word 'panic,' which

Fig. 5.—Fairy Ring Fungus (*Marasmius oreades*, Fr.), slightly reduced. A, Section.

means fear without a visible cause. Pan is said to have terrified people by sudden loud shouts, and to have sometimes ill-treated the inoffensive dancing fairy ring Oreads. If the botanist who walks over grassy hills happens to be an archæologist as well as a fungologist, he will possibly light on arrow heads of flint in country places, and especially in Ireland. These flint arrow heads are termed fairy darts or elfin shots, and they are associated with the sports and quarrels of the nymphs and fairies. Fairy rings are common in Ireland, but moles do not occur there; this is a difficult point for the mole theorists. Fairy darts of flint were at one time common in Ireland, but of late they have nearly all been bought up by Irish cow doctors, who lend them to rustics to boil in the same pot with hot mashes prepared for ailing cows and pigs, for these fairy darts are supposed to have a mystic and potent power for curing the diseases peculiar to oxen and hogs.

"After this slight digression in reference to the classic name and associations of the Fairy Ring Agaric, we may now notice the fungus itself. *Marasmius oreades* is generally about two or three inches high; its colour is slightly more buff than a biscuit. The same colour pervades

every part, the top being sometimes a shade darker than the gills and stem. Every part of the fungus is rather firm, and the stem tough, solid, and smooth. The gills are free from the stem, unusually broad and thick, and unusually distant from each other. The top is smooth and fleshy, and commonly furnished with a central elevation. It grows on grassy hills, sometimes on precipitous hill-sides or lawns in exposed wind-swept pastures, and amongst the short grass of roadsides. One of its chief characters is that it grows in, and causes fairy rings. The fungus is edible; indeed it is one of the safest and most delicious of all edible Fungi. It seems just possible, however, that occasional examples are bad eating, and cause stomach-ache and other unpleasant symptoms; but I am inclined to think that these indigestible examples are very rare, and may be classed with such things as stale eggs, tough beef, high venison, and rank butter. In fact, the high gastronomic character of the true Fairy Ring Champignon shines with a more brilliant lustre by contrast with a few alien individuals unfit for the table. However, in case of accidents, errors, or inconvenience, I always advise beginners in fungophagy to be provided with a bottle of sweet oil. If dizziness,

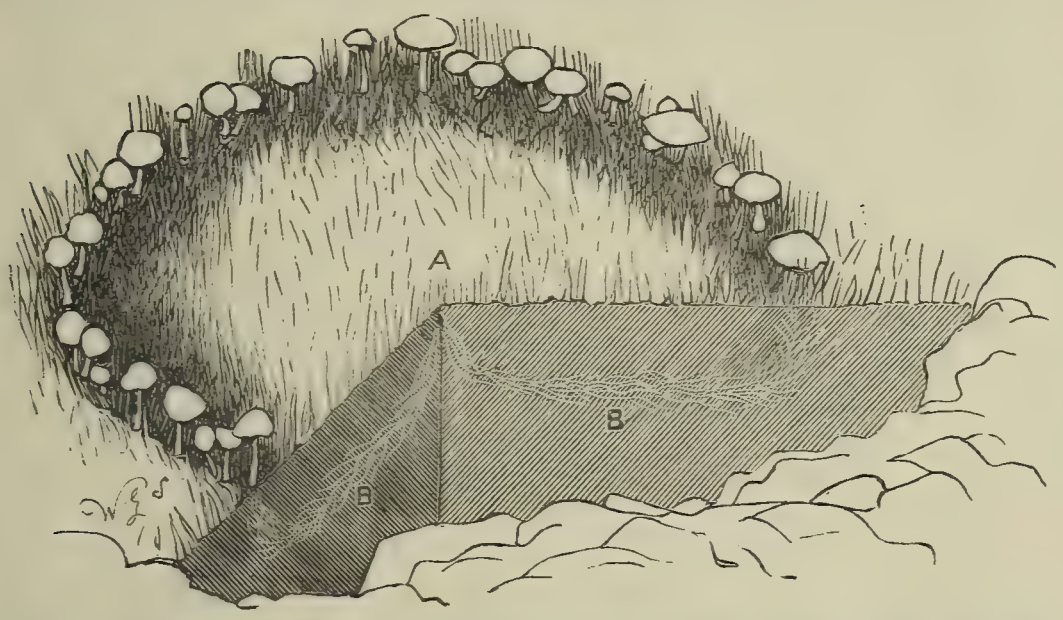


Fig. 6.—Fairy Ring. The ground partly shown in section, A centre, where the original Fungus has decayed, and whence springs the underground spawn, B. B., of the Fungus (*Marasmius oreades*), which gives rise to the Fairy Ring.

delirium, and cramp are found to be coming on, a draught of sweet oil is invaluable, for if enough be taken it causes immediate vomiting, and it tends to heal any damage that may be done to the throat and stomach by fungus poisoning. The Fairy Ring Agaric is extremely common, and grows from late summer to late autumn, so that it may be well esteemed as one of the greatest boons given to us by good fairies and the great god Pan.

"The true explanation of the nature of fairy rings has been so often printed that I am almost ashamed to refer to it before this Society. Several persons have written to me of late to ask what my 'theory' and what my 'hypothesis' is as to fairy rings. My reply has every time been that I have got no 'theory' or 'hypothesis' either, for the facts are so perfectly well known that they do away with any necessity for a 'theory.' Many Fungi have a great tendency to grow in circles. The spawn from which Fungi spring commonly starts from a spot made up of germinating spores. This spot becomes a centre from which the spawn extends outwards in every direction; a crop of Fungi appears on the outer circular line of spawn. (See Fig. 6.) Such ring-like

fungus growths are very common on decaying fruit and leaves. The fungus of ringworm is another very familiar example. Fairy rings, as formed by Agarics, probably start from a single fungus which has grown from wind-carried spores. The growth of the spawn of this single fungus in the ground renders the spot where the individual grew unfit to produce another fungus of the same class. The spawn then extends itself from the central spot, and grows all through the winter and following summer a circular patch in the earth. One year's growth will give a circle of about six inches, and on the outside of this little circle a small fairy ring of Fungi will appear the second year. When this ring of Fungi dies it acts as a rich nitrogenous manure for the grass, so that in the third summer a circle of rank fungus-manured grass is seen. The grassy circle is often in strong contrast with adjoining dead grass killed by the fungus spawn infesting the roots. If circumstances are favourable the underground spawn will now keep on extending itself for forty years or more, until at last an enormous circle is made that may sometimes be seen on hill-sides from a distance of a mile or more. If an obstruction occurs a semi-circle may sometimes result; at other times, when numerous rings grow near each other in the same pasture, or on the same hill-side, various ogee curves and wavy lines of rank grass, barren ground, and Fungi are originated. The whole phenomenon of ring growth is comparable with a stone thrown in still water. The stone is like the first few germinating fungus spores, and the ever-extending rings produced by the impact of the stone on the water are like the ever-extending rings produced by the underground spawn of the fungus. Sometimes a large fairy ring will appear in a place, as on a lawn, where no Fungi have been seen before, and where no smaller rings have preceded the large one. This phenomenon is caused by the first fungus being overlooked, and then a series of seasons have followed unsuitable for the production of the Fungi. The spawn, however, has been alive underground, and has kept on year after year extending itself till at last a suitable season arrives, and a crop of Agarics is the result at the circular margin of the underground spawn.

"It must not be supposed that the Fairy Ring Agaric is the only fungus capable of making a true fairy ring, for many Agarics and other Fungi are capable of doing this. Puff balls frequently form fairy rings. The St. George's Agaric, *Agaricus gambosus*, which grows in April, makes very strongly marked fairy rings. The spawn of this fungus chokes the grass in a remarkable manner, leaving the ground almost bare, and the fungus itself is so fleshy and large that it manures the circle where it grows in a most striking manner. Another very large fungus named *Agaricus geotrupus* causes unusually large and bold fairy rings. The Common Mushroom does not make rings, but a close ally, if indeed it is not a mere variety of the same plant, *viz.*, the Horse Mushroom, is said to produce rings. If so, this should be one reason for making the two Fungi distinct species. There is also an extremely small Agaric named *Hygrophorus niveus* that I have seen growing in perfect rings only an inch or two across. Some fairy rings are found in woods, and a notable example is found in *Agaricus fastibilis*. This forms grassy rings inside woods quite distinct from the drip of the trees, for the rings often envelop several trees and many bushes in their circumference. Such rings, I suppose, are the dancing places of the dryads, nymphs who also danced and frolicked to the pipe of Pan. As far as I know, Fungi which grow in circles have never been catalogued and distinguished from those which grow in an irregular or sporadic manner. Some certainly can grow in a line, for I once noted a number of specimens of *Helvella crispa* which

grew in a line for several years. Such a catalogue if made would be very valuable, and if members of this Club will note and measure rings and determine the Fungi growing upon them they will be doing good service and new work. Why some Fungi grow in rings and others in a straight or an irregularly branching line it is difficult to say, but if Fungi have been evolved from other fungus forms, and Fungi as we now see them have descended from one or more common ancestors, then those ancient precursors may have taken up with different habits which are still retained by their descendants. Fungi growing in rings or branched lines appear to me to be comparable with regular flowers, alternate and opposite leaves and similar phenomena seen amongst flowering plants. It is known that the flora of the inside of a ring is somewhat different from the flora outside, and that the grassy ring itself will support plants that neither grow outside nor inside the ring. A most useful piece of work would be the making of lists of grasses and other plants seen outside and inside the ring. During the present summer I noticed a profuse flowering of the Common Rock Cist, *Helianthemum vulgare*, amongst the luxuriant grass of fairy rings. The plant occurred elsewhere, but it only flowered well on the rings. To such an extent was this the case that I could distinctly see the rings as yellow circles from a long distance. The change of the flora is caused by the Fungi exhausting the ground and then re-manuring it with highly nitrogenous manure. This manure causes luxuriant vegetable growth for one year, which exhausts the circle to a still greater extent. The soil inside the ring is therefore different from the outside, and supports different plants. Another point that requires investigation is the source of the nitrogen so abundant in Fairy Ring Fungi. These Fungi only grow in bare pastures and other places where nitrogen is rare, yet they acquire so much nitrogen in themselves that when they perish they deposit so much of this material and potash on the soil that the manured circle resembles rather the grass of the richest meadow than an upland pasture. It has not yet been decided whether Fungi are capable of acquiring their large store of nitrogen direct from the air or from material in the soil."

Then followed Dr. Wharton, M.A., F.Z.S., who took for his subject a more utilitarian, but not less interesting, aspect of Fungus-lore in the following paper:—

On Fungi as Food.

"We fungus-hunters will get more thanks from the world at large some day than we do now, when people who never aspire to being botanists know the variety and charm of the flavours we can introduce to them. The inventor of a new dish has long been held worthy of the highest honour. How shall we stand when the rich realise the gratifications we can bring to their palates? They who relish so keenly the mushroom and the truffle have yet to learn the delicious changes we can find for them in what they have been taught to despise as 'toadstools.' Given even such a slight knowledge of Fungi as anybody may obtain from Dr. Cooke's little book, and the will to hunt for and identify the right species, and anybody may live many years before he has tasted all the palatable dainties that are within his reach. The fungus-hunter has double the advantage of the poet, in that he is 'made' as well as 'born.' My own experiences may well illustrate the few remarks I wish to offer, and show how one's scientific interest in Fungi may be sharpened by what the vulgar deprecate as 'pot-hunting,' to hide their idle ignorance.

It is true I hunt for the despised 'pot' still, and it gives a zest to the pursuit to know that if I neglected the scientific aspect I should always be haunted by the spectre of 'death in the pot.' My first essay was on the Common Champignon (*Marasmius oreades*). I found it growing in a friend's field just after I had bought Mr. Worthington Smith's admirable Plates of Edible and Poisonous Fungi. The only other book I had then to help me was the little one of Dr. Cooke's, to which I would refer those who wish to know all the interesting details of fungus-cookery. Still I had no doubt about the species, and I straightway had those Champignons cooked—not forgetting an epitaph I was familiar with in my childhood in Mitcham churchyard on a family who died from eating so-called 'Champignons.' I thought I was too far advanced in the scientific stage to be myself mistaken. And delicious I found my Fungi in the eating. But the friend on whose grounds I had gathered them, though he entrusted me with the care of the health of himself and his family, had misgivings about my botany. That same night on which we feasted on his 'toadstools' he took the trouble to come and inquire whether we were still alive. His pleasure was only equalled by his surprise. He still thought we must be moribund—doomed by a latent poison. Next morning he sent one of his sons, with such a rueful countenance, on the same errand. I believe that to this day he has his doubts as to whether we really ate them at all! Since then I have brought home and tasted twenty-five other species. I must not include the truffle in the present list of Fungi I have eaten, and should like to eat again, for I have never had the good fortune to find it growing. And there are many other delicacies I still keenly look forward to becoming acquainted with—particularly the Giant Puff Ball (*Lycoperdon giganteum*). At present I merely wish to give an account of the twenty-six species I have found and eaten. If I could only make the recital as agreeable as the fruition!

"To take the species in their usual botanical order, I must begin with one, *Amanita rubescens*, that is among the least commendable; but although I cannot praise it much as an *entrée*, it makes a capital ketchup. The next, however, *Lepiota procerus*, is indeed delicious—soft and savoury. Its close ally, *Lepiota rachodes*, I have found quite as great a dainty, although Mr. Worthington Smith says 'it cannot be so highly recommended, if it even be wholesome.' Certainly I never had the chance of eating enough to verify the last aspersion, much as I should like to try! Our familiar friend of protean aspect, *Armillaria melleus*, I cannot say too much for; it is generally tough, and always insipid. *Clitocybe nebularis* has a pleasant fragrance and delicious flavour. But what is this compared with its congener, *Clitocybe odorus*? The scent of new-mown hay, or melilot, or of the breath of a cow that has browsed on Dutch clover, gives but a faint idea of its charming odour; I have only eaten two specimens, but the taste was as delicate as the smell. *Pleurotus ulmarius* and *P. ostreatus*, like most other Fungi growing on the trunks of trees, can only be described as 'edible' in contradistinction to 'poisonous.' I shall never go out of my way to hunt for much flavour in them again. But when I come across *Clitopilus prunulus* I know what a delicacy there is in store for me at home. Nothing can describe its bewitching relish—quite different from that of any other fungus I have tasted. We all know the true Mushroom of commerce (*Psalliota campestris*), so it wants no commendation at my hands. And we have all eaten its close ally, *Psalliota arvensis*, although we may not think it so great a luxury. But it has fallen to the lot of very few to taste the rare *Psalliota elvensis*. This I found last year in the Harrow district, growing in great abundance under trees on the top of a hill. It is a much finer-looking species than the Common Mush-

room, and while there is more of it in substance, its flavour is altogether more excellent. In it we seem to get all the virtues of the Common Mushroom in an enhanced and concentrated form. I lately made an expedition to the spot where it grew so freely last September, but I was not fortunate enough to find any specimens. In taste, as well as in aspect, *Psalliota elvensis* is truly the king of Mushrooms. So far the great genus *Agaricus*. In the next genus I have eaten two species. *Coprinus comatus* I can only characterise as rich. *Lactarius deliciosus* is so correctly named 'delicious' that it requires hardly any other epithet. Besides having a charming flavour, it makes a very solid and satisfying dish. Dr. Bull says it is perfect in a pie, with bacon, the crust preventing the escape of its aroma. The Chantarelle (*Cantharellus cibarius*) possesses in perfection the three virtues of colour, smell, and taste. My guests occasionally hesitate a little when I offer them some of our delicacies, but nobody tastes the Chantarelle without wishing—too often vainly—for more. I have already mentioned my affection for the Champignon (*Marasmius oreades*). It certainly is a jewel among Fungi, though so delicately and finely flavoured that it may be easily spoilt by an unappreciative cook. *Boletus edulis* is a fine plump species, which makes a most palatable and satisfying dish, such as a vegetarian might eat and fancy was some delicious meat in disguise. *Boletus granulatus* I tasted last week, through the kindness of my friend Dr. Cooke. Its inviting aspect is only equalled by its agreeable flavour; its nuttiness and its absence of sliminess make it superior to *Boletus edulis*. The 'Beefsteak Mushroom' (*Fistulina hepatica*) is a little disappointing as a substitute for beefsteak; but as an accompaniment it adds a charm to that dish such as few would imagine from its appearance. I think *Hydnum repandum* lacks delicacy and softness, but it is a fine ingredient in soups, and I have often found it a capital condiment when eaten raw with sandwiches in the woods. *Craterellus cornucopioides* has not hitherto, I believe, been mentioned as edible in our English books, though the French have long appreciated it. For all its looking so lowering and so leathery, it makes a very succulent and agreeable *entrée*. My last luxury, *Sparassis crispa*, is unfortunately rather rare. I have found it of an immense size in Black Park, near Uxbridge, and you may remember a gigantic specimen exhibited here by Mr. Worthington Smith last year. It is like a fine jelly in its softness and delicate flavour; even when eaten raw it is agreeable.

"Seeing that there are certainly three times as many Edible Fungi common in Britain as I have yet tasted, I have still fair hopes of many pleasures to come. It is unlikely that anybody else's experience of the same number of edible species will coincide with mine, so great is the variety everywhere around us. If we approach the question from the scientific side, we have no reason to fear the sad fate of Mr. Dodds; we must know each fungus *botanically* before we can safely eat it. I imagine that further experiments will tend greatly to enlarge our number of edible species, and that the list of poisonous ones is pretty accurately known already. And side by side with our increasing knowledge of the utility of Fungi as articles of food, I am happy to say that our knowledge also increases of the means by which we may counteract the ill effects of the poisonous species. The wonderful discovery that atropine is a perfect antidote to muscarine, the poisonous element of *Amanita muscarius*, gives us ground for hope that we may some day fearlessly try the effect of every fungus not hitherto known to be poisonous. But until that day arrives I for my part shall be content to enjoy that large number of species alone whose wholesomeness has already been incontestably proved. A great reward was once offered, as you are aware, by

a luxurious king to the inventor of a new pleasure. It is a pity that king is dead,—he lived so long ago, that he might just as well have lived a little longer,—for if he were living now we fungus-hunters might rejoice in a portion of his imperial wealth, and enhance our pleasure by teaching him a scientific appreciation of 'Fungi as food.'"

Want of time unfortunately prevented the paper standing in Professor Boulger's name ("On Rhizocarpeæ") from being read, albeit he had prepared a large number of diagrams and fresh and dried specimens to illustrate it. A few questions were asked on the several papers, and replied to by the writers, but there was no time for an extended discussion of any. Cordial votes of thanks were passed to the authors, and to those who had acted as Directors, and a most successful and interesting meeting was brought to a close by an inspection of the Fungi gathered during the day under the guidance of the botanists present.

[On Saturday, October 21st, the Hackney Microscopical Society held a meeting in the Chingford portion of Epping Forest for the examination and determination of Fungi, under the guidance of Dr. Cooke, Mr. Worthington Smith, and Mr. English. As this portion of the Forest has not yet been explored by the Club it may be interesting to quote a few remarks on the species observed kindly furnished by Mr. Smith :—

"The heavy downpour of rain, the driving wind, the scudding leaves, and the deep tenacious mud made botanising rather difficult. Two interesting species of the subgenus *Flammula* were speedily met with in *Agaricus flavidus* and *spumosus*. Some fine specimens of *Agaricus dryinus* were gathered from the trees. Another tree produced several specimens of the beautiful, and by no means common, *Agaricus adiposus*, with a bright sulphury top covered with thick adipous gluten. The grassy places were thickly dotted with different species of *Hygrophorus* and the yellow *Clavaria inæqualis*. Many specimens of *Coprinus* were met with, and *Agaricus stercoriarius* and *A. appendiculatus*. The Beech trees produced the beautiful *A. mucidus* and *Polyporus cuticularis*, and the old Oaks exhibited the vegetable beefsteak, *Fistulina hepatica*. The vegetable oyster, *Agaricus ostreatus*, was met with in several places. Amongst interesting species growing on the ground was *Polyporus rufescens* and many examples of the uncommon fungus named *Agaricus worthingtonii* by Professor Fries. An example or two of the edible *A. procerus* were found, with a large number of common species."]

Saturday, September 30th, 1882.—Ordinary Meeting.

The thirty-first Ordinary Meeting of the Club (being the first meeting of the Winter Session) was held at the Head-quarters at seven o'clock, the President in the chair.

Contributions to the Library were announced from Miss Saul (20 vols.), Professor Boulger, Mr. J. E. Harting, Mr. Andrew Johnston, Mr. Meldola, and Mr. Fisher Unwin. Miss Marian Ridley presented to the Museum an almost complete collection of British Ferns, neatly mounted,

and Mr. Hope some specimens of Essex sea-weeds. It was announced that an Entomological Cabinet of thirty drawers had been purchased for the Museum.

The following were elected members of the Club:—Messrs. C. M. Bayfield, G. Biddell, Frank Evershed, F.I.C., D. Radford Sharpe, F.M.S., F. H. Spiller, and A. Godfrey Wells.

The Secretary read a letter from Mr. Francis Darwin, returning the thanks of Mrs. Darwin and family for the vote of sympathy and condolence upon the death of the late Charles Darwin passed by the Club on April 29th last.

Mr. English exhibited specimens of a supposed gall which he had found about the middle of September in the seed-pods of the Common Broom (*Cytisus scoparius*) growing in Epping Forest. The normally black ripe pods presented a somewhat remarkable appearance, inasmuch as they were partly coloured—some half black and half green, and some wholly green. On examination he found that the green portions of the pods enclosed what he took to be an elongated gall, each containing a larva. In some cases the perfect insect had emerged, leaving part of the pupa-case protruding. [Judging from an examination of the dried specimens exhibited by Mr. English, we are disposed to think that they are really galls, caused by the larvæ of one of the Cecidomyidæ, *Asphondylia sarothamni*, Lw. In a paper on "The *Asphondyliæ* of the Glasgow district" (Proc. Nat. Hist. Soc. Glasgow, vol. iii., p. 111), Mr. F. G. Binnie describes three forms of this gall as occurring on the Common Broom, *viz.*, two axillary, and one on the pod. He thus refers to the galled pod:—"The part affected becomes inflated, is oval or round in shape, circular in transverse section, and projecting equally on both sides of the pod. It is thin-walled, forming an internal cavity which contains a single larva, and the galled portion retains its green colour after the rest of the pod has become black. The perfect insect emerges by a hole in the side. The gall is found during the summer, and the present species (*A. sarothamni*, Lw.) has been bred from it by Mr. Traill. I have only seen it in one locality, near Milngavie, and have failed to find it elsewhere." Some of the largest species of the Family Cecidomyidæ are, according to Mr. Binnie, found in the genus *Asphondylia*, and the pupæ are provided with two projecting tooth-like processes at the anterior end, to assist them in forcing their way through the tissues of the enclosing galls when about to assume the perfect state. All this accords well with Mr. English's observations. One of the axillary galls of *A. sarothamni*, "usually crowded together on the apical portions of the twigs," is mentioned in Mr. Fitch's "Galls of Essex" (Trans., vol. ii., 123), but the galled pod of the Broom does not appear in his list.—Ed.]

Mr. W. Cole said that while on the subject of galls he might mention one which Mr. A. Lockyer and himself had found early in June in the Forest, during the explorations at the Loughton Camp. Young leaves

of the Oak were observed to be folded over at the margins, forming elegant little lappets or "tents," each containing a larva. Mr. Fitch supposed the gall to be the work of *Cecidomyia inflexa*, Bremi, a species *new to Britain*. Very little appears to be known of it. Kaltenbach says—"I found the larva repeatedly under smooth folded leaf lappets on low Oak bushes. The full-fed larvæ fall from these to the earth, and there complete their metamorphoses." Mr. Cole also exhibited specimens of the new Violet-gall (*C. violæ*, described *ante* p. lxiv) from Monk Wood.

Mr. N. F. Robarts exhibited a small geometriform caterpillar (of the genus *Eupithecia*, either *E. nanata* or *E. minutata*), which he had found upon the Common Ling in the Forest. It struck him as affording a tolerably good case of "mimicry"—the markings and colours of the *larva* matching well the peculiar mottled, purple-and-white, appearance of the faded flowers of the *Calluna*.

The President remarked that it would be well to limit the word "mimicry" to denote those cases in which an insect copied the markings of another insect, and to use the phrase "protective resemblance" to express the imitation of the colours and forms of inanimate objects by an insect or other living creature.

The Secretary exhibited, on behalf of Dr. Snell, a flower-head of the Common Onion, grown in a garden at Stoke Newington, showing an abundance of adventitious buds or bulbs (*bulbils*), which eventually fall off and produce new plants.

He also exhibited a fine specimen of the somewhat rare Longicorn beetle, *Prionus coriarius*, which had been caught by his brother, B. G. Cole, flying in the evening at Buckhurst Hill, on August 7th, 1882.

Mr. Compton Warner showed a walking-stick made out of the stalk of the variety of the Cabbage commonly grown in Jersey for that purpose. He had been told that the plant would not flourish so far north, but the specimen exhibited had been grown in his own garden at Woodford.

The Secretary exhibited, on behalf of Mr. Argent, some Humble-bees (*Bombi*), which Mr. Argent had found in July last under a Lime tree in South Devon. Some of the bees were eviscerated and quite dead when found; others were alive, but seemed to be stupefied and scarcely able to crawl. During a visit to South Weald, Essex, on August 7th last he (the Secretary) had found (in company with Mr. Meldola, Mr. Argent, and his brother) a *very large* number of *Bombi* lying under the Lime trees near the village. None of these last were living, and nearly all the specimens had been eviscerated. He had not been able to find references to a similar occurrence in any entomological books, and had therefore applied for information to a well-known hymenopterist, Mr. E. Saunders, F.L.S. That gentleman was not prepared with an explanation, but suggested that the bees might have been tempted by the abundant honey of the Lime blossoms to remain out after sunset, and that then the cold nights had numbed and killed them. Mr. McLachlan had suggested that

the bees fell victims to the attacks of wasps. The idea that the bees had been poisoned could not be entertained, inasmuch as Mr. Cole had always understood that the nectar of the Lime tree was an excellent honey-making material.

Mr. Stevens (the apiarist), who was present as a visitor, confirmed this, and said that Lime blossoms were highly valued by bee-keepers.

The President referred to a note by Mr. Slater read before the Entomological Society, in which certain flowers, notably the dahlia, the passion-flower, the crown imperial, and the oleander, were stated to have a narcotic action upon Humble- and Hive-bees. The Rev. L. Jenyns, in his 'Observations in Natural History,' mentions that bees which visit dahlia flowers are "soon seized with a sort of torpor," and often die unless speedily removed. He quotes also a writer in the 'Gardeners' Chronicle,' who pronounces the cultivation of the dahlia "incompatible with the success of the bee-keeper."

Mr. R. M. Christy said that the phenomenon in question had been discussed in a little magazine published by the Natural History Societies attached to the Friends' Schools, and there he thought *birds* were accused of the death of the bees.

[By Mr. Christy's kindness we are enabled to give the following extracts from 'The Natural History Journal, conducted by Societies in Friends' Schools,' vol. iv. York, 1880 :—

"Bees Eaten out Hollow.—On the 25th July my children found under a large Lime tree in my garden, which was then in full flower, between 50 and 100 dead and dying bees. They were all of the same species, the Common Yellow-banded Humble-bee, *Bombus terrestris*, I believe [= *B. virginalis*, K]. On examining these I found that nearly all of them had their insides eaten away ; in most cases the abdomen had been excavated, but in some the thorax, and several wanted the head. Usually the hole was a large one, and all the soft parts were gone, leaving only the shell. One which I found had the whole of the thorax excavated from the back, which had been eaten away, with a hole one-tenth of an inch in diameter, yet the insect was still alive, and crawled about for more than an hour. Were these bees stupefied or poisoned by the honey of the Lime tree, and afterwards attacked by some predatory insect when on the ground?"—*F. W. Pim, Monkstown, Co. Dublin.* (*loc. cit.*, p. 129).

This letter was submitted to Mr. W. D. Roebuck, of Leeds, who commented upon it as follows :—"It is noticeable that a case precisely similar to that detailed by Mr. Pim was brought under my notice in 1877 by Mr. James Varley, of Huddersfield. (See 'Naturalist' for October, 1877, vol. iii., pp. 40—41.) . . . . Mr. F. Smith suggested the probability of the bees having been killed by *birds*—perhaps by the Butcher-bird or Shrike. Shrikes feed with avidity upon Humble-bees, and on one occasion Mr. Smith saw a Shrike flying about in a bean-field where *Bombi* were swarming, catching them, then settling on a gate-post for a few seconds to devour portions of its prey, and then off again for fresh captures. This still seems to me the most intelligible way to account for the phenomenon. The blossoms of the Lime being attractive to bees, would cause them to congregate thickly ; this aggregation of bees would in its turn attract the attention of birds, which would reject the

hard external cases when feeding on the soft interior of the insects. . . . . With regard to Mr. Pim's questions, I can readily comprehend that the blossoms of the Lime may possibly stupefy or poison the bees, and so render them an easy prey, but I can hardly see that they were stupefied to a sufficient extent to cause them to drop to the ground; for neither he nor Mr. Varley seems to have seen any unmutilated and living bees on the ground. It is a familiar sight in the country to witness the antics of an intoxicated Humble-bee on certain flowers rich in nectar, and their unsteadiness is as noticeable as that of a human being under the influence of drink, the cases seeming to be parallel."

On page 145 of the same journal, Mr. J. S. Wood, of Nyborg, Denmark, states that the phenomenon is by no means rare, but is not brought about by the bees being stupefied, but by their congregating at the flowers, and so affording a rich hunting-ground for the birds. He names the following species as having been observed at Lime-trees:—Woodpeckers (the Green, Great-spotted, and Lesser-spotted), Nightingale, Redbreast, Swallow, Spotted Fly-catcher, Butcher-bird, White-and-Grey-headed Wagtails, House- and Tree-Sparrows.

The above remarks are certainly suggestive, but nevertheless we are disposed to think that the bird theory hardly explains all the facts very satisfactorily. If birds be the sole culprits, how is it that the dead and dying bees are found thickly strewn *immediately under* the trees? Having caught the bee, we suppose most kinds of birds would be compelled to fly with it to some "coigne of 'vantage" for the drawing process, and, the *bonne bouche* being consumed, the chitinous skeleton of the insect would be cast away at some little distance from the attractive Lime trees. Surely few birds could eviscerate a large *Bombus* whilst in the act of flying? The subject is one well worthy of a little careful observation.—Ed.]

Lieut. Croft, R.N., F.L.S., read a paper entitled "Notes on the River Lea," being a sketch of the topography and natural history of the river from its rise to its mouth. The paper was illustrated by numerous maps of the Lea-valley districts and tributaries.*

A brief discussion took place, in which the President, Mr. N. F. Robarts, Mr. W. White, and the author took part. The limits and direction of the ancient Roman road, the geology of some portions of the Lea Valley, the existence of camps and other prehistoric remains were touched upon, and a cordial vote of thanks was passed to the author.

Mr. A. P. Wire read the following:—

Second Note on the Woolwich Beds at Leyton, Essex.

"A further and more careful examination of the mud of the Woolwich beds at Leyton (see Proc. *ante*, p. iii.) showed that the list of organic remains might be somewhat extended. Of some of the species only a single specimen could be found, and as before stated hardly a whole shell exists in the deposit. As far as they can be identified, the following is a list of the Mollusca:—*Hydrobia parkinsoni*, *H. websteri*, *Cerithium* sp., *Cyrena cordata*, *Planorbis* sp., *Valvata* sp., *Ostrea* sp., *Melania* sp. In addition to these shells there were found small masses of iron

* This paper was subsequently withdrawn by the author, and was read at the meeting of the Hertfordshire Nat. Hist. Soc. on April 21st, 1883.

pyrites, pieces of wood and vertebræ of fish. The iron pyrites arose, I suppose, by the decomposition of the animal matter.

"When, some months ago, these beds were examined by me, the questions foremost in my mind were—How were these beds formed, and are beds of a similar nature being deposited now? A close and careful examination of the mud of the Woolwich beds—for mud it undoubtedly is—led to the inference that it must have been deposited very quietly either at the edge or at the bottom of a slowly-moving stream, whose gentle ripple laid the fragments of shells in a soft mud. That it was a very gentle current is evident from the fact that scarcely any pebbles are found in the mud.

"Upon examining the banks of the Lea as it flows through the Leyton Marshes, I found mud containing abundance of broken shells, bits of coal, fish-bones, &c. In this mud the genera of the Woolwich beds are represented by recent shells. Instead of the *Cyrena* we have *Cyclas* and a large mussel, the only genera having species in both Woolwich beds and recent mud being *Planorbis* and *Valvata*.

"Upon comparing specimens of the two muds, one cannot but be struck with their similarity, and cannot help coming to the conclusion that the two had a similar origin, namely, the washing up of the detritus by a gentle current, and its quiet deposition on the side and in the bends of the river channel. Specimens of both are laid on the table for comparison."

Mr. Wire exhibited a series of specimens, in illustration of the note, obtained from the sewerage works then being carried on in the high road south of Leyton railway-station. He further remarked on the points of similarity between the Woolwich beds and the beds which the river Lea is at present depositing, arguing therefrom that the Woolwich beds were deposited by a slowly-moving stream.

Mr. N. F. Robarts said that they must not seek to connect the deposits now being accumulated in the Lea Valley in any way with the deposit which forms the Woolwich beds. There was no connection whatever between the two.

The President thought Mr. Wire's specimens and observations well worthy of consideration, but he agreed with Mr. Robarts that there was probably little similarity in the conditions now observable in the fresh-water deposits of the Lea, and those which obtained when the Woolwich beds were deposited. Mr. Wire would do well to make sectional drawings of the beds at Leyton.

The usual conversazione concluded the meeting.

SATURDAY, OCTOBER 28TH, 1882.—ORDINARY MEETING.

The thirty-second Ordinary Meeting of the Club was held at the Head-quarters at seven o'clock, the President in the chair.

Contributions to the Library were announced from Dr. Cooke, Mr. T. V. Holmes, and Mr. W. White.

The following were elected members:—Ferdinand Coles, F.L.S.,

Frederick Mitchell, Mrs. Sapsworth, Mrs. John Spiller, W. Stacpoole, and J. E. Stacpoole.

The Secretary read the following letter:—

"British Association for the Advancement of Science,
"22, Albemarle-street, W.,
"October 17th, 1882.

"Sir,—I am directed by the General Committee of the British Association for the Advancement of Science to transmit to you the following copy of a resolution which was adopted by the Committee at the last meeting of the Association, and to request your attention to it, and to the annexed extract from the rules of the British Association:—

That Mr. R. Meldola, General Pitt-Rivers, Mr. Worthington Smith, and Mr. W. Cole be a Committee for the purpose of investigating the ancient earth-work in Epping Forest known as the Loughton Camp; that Mr. W. Cole be Secretary; and that the sum of £10 be placed at their disposal for the purpose.

[Here follow rules as to grants of money.]

I have the honour to be,
Your very obedient servant,
T. G. Bonney,
Secretary.

To W. Cole, Esq."

Mr. Oldham exhibited some butterflies taken at Folkestone last summer (1882), including *Colias edusa*, and the aberration *helice*, with some *female* specimens of *Lycæna adonis*, remarkable for their extremely blue colour, compared with the ordinary brown form of this sex of the butterfly.

Mr. R. M. Christy exhibited some nutlets of the Hounds-tongue (*Cynoglossum officinale*) as being one of the most prehensile seeds with which he was acquainted. Many common plants bear seeds provided with innumerable simple hooks, but the hooks with which the *Cynoglossum* seeds are furnished are superior to these to the same extent as a kedge anchor is superior to a piece of bent iron as a secure hold for a vessel, and in precisely the same way. The nutlets are covered with many spines, each having four or five small, but very sharp barbs, set round its tip, so that when seen from above they resemble a star, and when applied to one's coat or to a sheep's back they stick with remarkable firmness. He also exhibited some achenes (or "seeds") of *Geum rivale* which he had gathered on the shores of the lake of St. Moritz in the Engadine last August. The "seed" is pointed at each end, and one end is furnished with a long arm, about four times as long as the achene, which has some rather long hairs down the sides, the tips of the hairs pointing away from the "seed." The extremity of this arm makes a double curve, forming a hook as in many other plants, but to the point of the hook is jointed a long feathery awn. This is also hooked at the proximal extremity, and is very easily detached. Mr. Christy considered that these peculiar structures undoubtedly had some connection with the mode of distribution of the seeds, which he could not explain, although somewhat similar awns occur in the genera *Stipa* and *Erodium*. Sir

John Lubbock does not appear to mention these structures in *Geum* and *Cynoglossum* in his paper on "Fruits and Seeds."

The Secretary exhibited, on behalf of Mr. Reginald Christy, a specimen of the "Drinker Moth" (*Odonestis potatoria*), bred from a pupa found in Wicken Fen, Cambridgeshire, in June last. The specimen was a female, but the colouring approached in many respects that of the male moth.

Mr. Meldola remarked that Mr. Jenner Weir exhibited at the Entomological Society in 1880 a male *O. potatoria*, having two-thirds of the upper wings of the yellow colour of the female, and also a female moth tinged with the usual red-brown colour of the male. Speaking from memory, he thought the latter specimen was similar to Mr. Christy's.

Mr. T. Vincent Holmes, F.G.S., &c., read a paper "On Deneholes." [Trans., vol. iii., p. 48.] The paper was illustrated by geological maps of the localities mentioned, together with enlarged coloured plans of the deep denehole in Eltham Park, the pits visited by the Club in Hangman's Wood, ideal sections of the subsidences on Blackheath, and a drawing of the presumed "evolution" of such a hole as the six-chambered one in Hangman's Wood into one of the spacious pillared caverns found in some of the Stankey Wood "denes."

Mr. Henry Walker said that a more delightful paper, showing on evolutionary principles the construction of Deneholes, one could not have wished to hear. The formation of the Stankey Wood Deneholes from the double trefoil forms was a new idea, but he was sure that Mr. Holmes was right, and that the Essex Deneholes were the older. The paper was perhaps the first important step towards a genealogy of Deneholes. If anybody stood on the platform of the British Association and announced that, within twenty or twenty-five miles of London Bridge, there were at least a thousand shafts from thirty to eighty feet deep, many of them chambered at the bottom, giving every indication of primitive pit-villages, there would be a great sensation throughout England. At present the Essex Field Club had not that platform, and Mr. Holmes had shown that some of our most eminent scientific men were in arrears of interest about these ancient villages. He supposed they had been put down in guide-books and elsewhere as simply the haunts of pirates and smugglers, and pooh-poohed in that way. The discovery of a Stone Age had given quite a new interest to these mysterious excavations, and (referring to some remarks in the paper) Mr. Walker thought that if Buckland had known of a Stone Age, he would have seen that there were some chronological data to go upon. Now that the fact of a Stone Age was so well known, it was wonderful that there was not a more general recognition of the great interest of these excavations; he hoped that the Essex Field Club would have the honour of creating a little scientific curiosity as to their origin. It would have occurred, perhaps, to most of them to ask why Deneholes were so common in the south of England and not in the north. The explanation he conceived to be that we had

not in the south of England inland cliffs of limestone rocks as in the north of England. There they could drive a hole horizontally and make a cave, but in the south of England there was no alternative for primitive man but to go down into the earth. It would be exceedingly interesting to learn, although he was afraid this was impossible, whether prior to the great submergence of England men lived in any such excavations. Necessarily all the Deneholes that we found were subsequent to the Glacial Period,—that was, the period of submergence,—and he was afraid that we could not hope to know what kind of dwellings man made for himself before the Glacial Period, because they would have been destroyed by the submergence of England.

The President remarked that it was the bounden duty of the Club to take up the systematic investigation of the Deneholes—[applause],—and when the work at the Loughton Camp was finished he should propose that that be the next problem they took in hand.

Mr. Robarts asked whether Mr. Holmes had made any progress in ascertaining what kind of tools had been used in the formation of the holes—whether the picks used were made of metal or bone.

Mr. Holmes did not think that point could possibly be determined until the heaps of *débris* at the bottom of the pits had been thoroughly investigated. There were some marks of an iron pick in the last pit visited [see *ante*, p. lvii.], but it is impossible to say when they were made. They might have been made by John Smith or somebody who had written his name as being there in 1820. [Laughter.] They were so very conspicuous that he was inclined to think they were made by John Smith or one of his friends.

Dr. Cory, Mr. Letchford, and Mr. W. Cole also took part in the discussion, the latter stating that Captain Wingfield, the owner of Hangman's Wood, and Mr. Biddell, his agent, had very courteously given full permission to the Club to excavate the pits and to carry on any explorations considered necessary. A cordial vote of thanks was passed to Mr. Holmes for his paper.

Mr. R. M. Christy read portions of a very long essay entitled "On the species of the genus *Primula* in Essex; with observations on their variation and distribution, and the relative number and fertility in Nature of the two Forms of Flower." [Trans., vol. iii., p. 148.] The author illustrated his paper with diagrams and maps, and by the exhibition of his fine herbarium of species and aberrations of the Essex Primulas.

Owing to the late hour but a brief discussion was possible, in which the President, Mr. W. White, Mr. W. Cole, and the author took part, and the thanks of the meeting were passed to Mr. Christy for his exhaustive and interesting paper.

Mr. English also exhibited specimens of the genus *Primula*, both wild and cultivated, preserved by his well-known process, in illustration of the paper.

The usual conversazione followed.

SATURDAY, NOVEMBER 25TH, 1882.—ORDINARY MEETING.

The thirty-third Ordinary Meeting of the Club was held at the Headquarters at seven o'clock, the President in the chair.

Donations of books and pamphlets were announced from Mr. R. L. Barnes and Mr. P. F. Copland. An almost complete set of the "Reports of the British Association for the Advancement of Science" was presented to the Club by the General Committee of the Association.

Mr. G. P. Hope sent two specimens of the "Golden-eyed Garrot," and one of the "Red-necked Grebe" in the flesh, which were placed in Mr. English's hands for preservation.

A letter was read from the Committee of the Lewisham and Blackheath Scientific Association offering to contribute £5 towards the expenses of the projected Denehole explorations. The Secretary also announced that Mr. T. V. Holmes had promised £5 in aid of the same.

Hearty votes of thanks were passed for these contributions.

The following were elected members of the Club:—Messrs. R. W. Christy, R. G. Fletcher, David Houston, F.L.S., F.R.M.S., E. Rosling, F.R.M.S., Isaac Scarf, F.C.S., Charles Taylor, and Charles Tighe.

Mr. N. F. Robarts was nominated auditor of the Treasurer's accounts on behalf of the Council, and Mr. Letchford on behalf of the members.

The President said it would be remembered that Mr. Oldham had, at the last meeting, exhibited some butterflies, amongst which were two female specimens of *Lycæna adonis*, which were remarkable on account of their being blue like the males. He had been asked by a member what the use of exhibiting these varieties of colour in the Lepidoptera might be. He thought there was a very decided usefulness in such exhibitions. Those who were familiar with butterflies knew that there was a very remarkable phenomenon which had been very much worked upon by Wallace. He referred to what was known as dimorphism and polymorphism. A male butterfly would range over a very large tract of country and be perfectly constant over the whole district; and that one butterfly would have associated with it several females distinct in marking and in coloration. They were often so distinct that for years they had in some cases stood in entomologists' cabinets under distinct names. He had not seen any theory propounded as to the physiological meaning of this phenomenon; but in a note to his translation of Weismann's 'Studies in the Theory of Descent,' he had collated certain facts which seemed to show that the phenomenon had arisen from simple variability; and he considered that Mr. Oldham's specimens were corroborative of this view. In our commonest blue butterfly—*Lycæna alexis*—the male was invariably blue, but the female varied from brown with hardly any trace of blue on the wings to specimens almost as blue as the males. He was inclined to think that in such facts as these we had that groundwork upon which the unknown factors which had led to the production of dimorphism could operate. If we supposed in such a species all the forms intermediate between the blue and the brown forms to become

extinct, we should then have a case of dimorphism. The same thing was to be seen in our "Clouded-yellow butterfly" (*Colias edusa*); there were two distinct forms of female, in one of which the ground-colour was precisely the same as that of the male, while in the other it was much lighter (ab. *helice*). Under ordinary circumstances we never found anything intermediate between these two forms, but it happened that one year—he thought it was 1877—this butterfly was very abundant, and swarmed all over the country.* Hundreds of intermediate specimens were then found, and he considered that these were "reversion forms," showing that this phenomenon of dimorphism had arisen from simple variability. On the whole he thought that such varieties as had been exhibited by Mr. Oldham would be found one of these days, when the whole of the facts were carefully worked up, to be of very great importance indeed, because the phenomena of dimorphism and polymorphism were at present inexplicable. This was one more reason for bringing forward facts bearing on subjects of which they knew so little.

The Secretary stated that he had received from Dr. Cooke a list of Hymenomycetal Fungi, new to the Forest district, observed in 1882, being a supplement to the list published in the last volume of the 'Trans-actions' [vol. ii., p. 181]. It recorded 36 species, including *Cortinarius renidens* before noticed [*ante*, p. lxi.] [This list is reserved for the present for the purpose of including in it the species noted in 1883, &c.—Ed.]

He also read a note from Mr. Reginald W. Christy, who recorded the capture of a specimen of *Colias edusa* ♂ on September 22nd, 1882, at a place called Chalk End, in the parish of Roxwell, being the first specimen he had seen in Essex since the famous year 1877. On October 1st he saw two other specimens (male and female) near Writtle.

Mr. W. White exhibited some aberrational forms of the two "Fritillary" butterflies *Melitæa artemis* and *Argynnis euphrosyne*. One specimen of the former species had the ochreous "ground colour" of the upper side abnormally pronounced, developing into large tesselated spots, while another specimen showed a subdued orange-brown tone pervading more or less the whole field of all the wings. The variation in *A. euphrosyne* consisted in the enlargement of the black patches, more especially on the lower wings, and the commingling of them near the basal portion into one black area containing a conspicuous eye-like spot of black upon a well-defined "mirror" of the orange-brown colour of the groundwork. The normal forms of each species were placed with the specimens for comparison. Mr. White also exhibited an interesting

* It may be worth recording that in the above-mentioned year—which will long be remembered by entomologists as the great "*Colias* year"—*Colias edusa* was extremely common in many parts of the Epping Forest district. In Dr. Sewell's clover fields at Woodford Bridge we secured a very long series of *C. edusa* ab. *helice*, including one or two intermediate forms such as those alluded to by Mr. Meldola.—Ed.

aberration of *Lycæna arion* (the "Large-blue" butterfly), the underside of which corresponded with that figured by Newman in his 'British Butterflies' from Mr. Bond's collection. The upper side had a silvery "sheen," and differed somewhat from the usual type in other respects.

He also exhibited a "preserved" larva of an *Eupithecia* mounted on heath, as a reproduction of the specimen found by Mr. Robarts in Epping Forest [*ante*, p. lxxviii.], and which he thought was *E. nanata*. He wished to ask if it were generally known that the species occurred in the Forest, as both Stainton and Newman spoke of it as a North British species, although the latter added that it had been taken in Suffolk.

Mr. W. Cole remarked that *E. nanata* was a common species on Shirley Heath, Surrey, where he had often "swept up" the larva in the early summer, and his brother, Mr. B. G. Cole, had taken the imago in Epping Forest in 1878, the specimen being in their cabinet. He thought the moth was by no means a northern species, and that it occurred wherever its food plant, the Common Ling (*Calluna*), grew abundantly.

Mr. N. F. Robarts, F.G.S., read a paper entitled "Notes on the London Clay and Bagshot Beds at 'Oakhill Quarry,' Epping Forest." [Trans., vol. iii.] The author observed that no apology was necessary in bringing the subject before the Club, one of whose aims certainly ought to be to describe local sections as they are exposed, and thus preserve a record of them for the use of geologists generally, even if no new facts were to be learned from their examination. The paper was illustrated by sectional diagrams and maps, and the following specimens:—

London Clay, Sharks' teeth, Theydon Mount.
" " Septaria, Brentwood Brick Pits.
" " Iron pyrites and decayed ditto, Oakhill Quarry.
" " Ironstone nodules, " "
" " Cast of shell in sandstone, " "
" " Cast of shell in iron pyrites, " "
Bagshot Beds, Sand from altered Bagshot Pebble Beds, Oakhill Quarry.

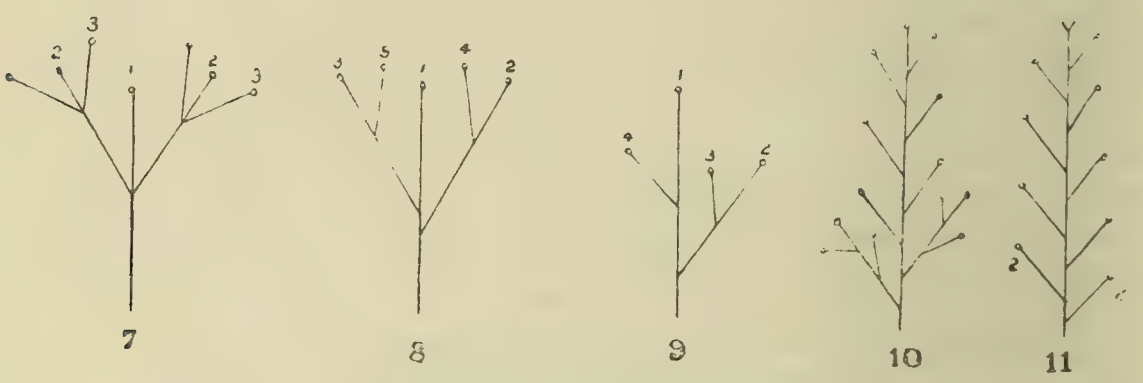
Professor Boulger, after thanking Mr. Robarts for his paper, said he had been especially interested in the general observations with which it was introduced, with reference to Mr. Searles Wood's theories. He was very reluctant to assume the existence of disturbances from mere surface features, as Mr. Searles Wood did. He should be much more inclined to adopt Mr. Robarts's suggestion that the steeper slope of the western sides of the elevations depended on the increased rainfall on the western sides, on account of the prevalent wind.

A short discussion ensued, in which the President, Mr. Wire, the author, and others took part.

The following paper by Mr. John Gibbs, of Chelmsford, was read by Professor Boulger, who lucidly explained the various points in it by *viva voce* expositions and by drawings on the black board;—

On the Relations to Each Other of Several Forms of Inflorescence.

To one who attempts to gain a knowledge of botany by the study of our native plants, as described in the best works on the subject, much perplexity arises from the obscurity as to meaning of the terms employed to distinguish the several forms of Inflorescence. Those terms were invented and their meanings well-defined before botanists had learned to attach much value to the distinction between the definite and indefinite systems under which the several modes of inflorescence are classed in modern works. When we are told that indefinite inflorescence is best illustrated in the form of a raceme, and learn from some good glossary that a panicle is a compound raceme, we may go on to learn on authority equally good that the "London-pride" (*Saxifraga umbrosa*) has its flowers in a panicle. We may thence conclude that the inflorescence of the "London-pride" is indefinite, in which inference we should be in error. For the panicle of the "London-pride" has a flower at the top which is the first to expand, and each of its principal branches ends in a flower with lateral flowers below it. Spikes, racemes, corymbs, and umbels, as well as panicles, are to be found with terminal flowers, and cymes, properly so called, do not always observe a centrifugal order in the expansion of their flowers.



Diagrams illustrating Mr. Gibbs's paper. The numbers where given indicate the order of expansion:—Fig. 7. Campion (*Lychnis*); centrifugal, opposite; branches simultaneous. Fig. 8. Buttercup. Fig. 9. King-cup (*Caltha*); corymbose. Fig. 10. Monkshood (*Aconitum*). Fig. 11. Wallflower; indefinite, centripetal.

After this it may be doubted whether the systems of inflorescence described as definite and indefinite are indeed so different as they appear to be in the writings of botanists. To those who hold the theory that species were created as distinct as they are now, and that intermediate forms result from hybridization, it is natural to take forms extremely different as typical, and to think of intermediate forms as mixed, a plan which we find followed still in elementary treatises on botany with a considerable number of terms so new and strange that in order to learn them we have need of all the virtue that an Englishman can boast of not being frightened at hard words.

It would seem, however, more in accordance with modern philosophy to look on all the forms of inflorescence as related to a primary or typical form from which we may consider them to be derived. Now, a flower is the natural termination of a stem or branch. The simplest form of inflorescence is that in which the flower is at the top of a stem, as in the Wood Anemone or Winter Aconite (*Eranthis*). When more than one flower grows upon a stem, it follows from the manner in which flowering plants branch that if one of the flowers be terminal, the next and those

which come after will be lateral or axillary. If the terminal bud be abortive, or if it continue to grow in prolongation of the stem, all the flowers will be lateral in their relation to the main axis, but may be either terminal or lateral in their relation to the branch which bears them. Let us look at the results of these contingencies.

In the King-cup (*Caltha palustris*) we have a stem whose terminal bud becomes a flower, and a bud in the axil of the uppermost leaf or bract is also a flower bud. This, the lateral, axillary or sub-terminal flower, does not expand so soon as the terminal flower. It is on a simple pedicel, which bears no bract nor any modification of a leaf below or outside the calyx, nor has it any capacity for branching. It is well to observe these particulars as they serve to distinguish this mode of inflorescence properly definite from any which can fairly be called centrifugal. From the axil of a lower leaf grows another branch, which, like the main axis, bears a flower at its top with a leaf or bract below it, in the axil of which is a sub-terminal flower.

It may appear that in such cases as the above, where there is a stem with many branches, each of which is capable of bearing several flowers, every such branch ought to be considered as a separate individual, and that the relation of such branches to each other and to the main stem which bears them ought to be regarded as a matter quite distinct from the arrangement of the flowers upon each peduncle. Looking at the subject from this point of view, I arrived at the conclusion that the arrangement of individual flowers on a peduncle or flowering branch is of more importance as to natural affinity than the mode in which peduncles or flowering branches are placed on the main stem.

The inflorescence of the King-cup is definite, but not centrifugal, for (1) the pedicel of the uppermost lateral or sub-terminal flower is simple, and with no capacity for branching; (2) the same uppermost lateral or sub-terminal flower does not commonly open so soon as that which terminates the branch immediately below it. In both of these particulars the inflorescence of the King-cup is in striking contrast to that of the Stitchwort (*Stellaria*) or the Campion (*Lychnis*), which is strictly centrifugal.

That the annual flowering stem of the King-cup, with all the branches growing on it, should be regarded as forming collectively a single system, all parts of which are related to each other, may be inferred from the facts of an apparent order existing in the expansion of their several flowers, and of the greater capacity for branching observed in those branches which spring from the lower part of the stem in comparison with those from its upper part.

The flowering stem of the Columbine (*Aquilegia vulgaris*), with its branches, forms an inflorescence more compact than that of the King-cup, but with a general resemblance to it; differing, however, in that the uppermost lateral flower-stalk is not a simple pedicel but a peduncle capable of branching, usually bearing two bracts below the flower, and often with flowers in their axils on stalks which may be properly called tertiary axes. In that the flower on the top of the main stem is the first to open, and that which terminates the secondary axis comes before that on the tertiary axis, this plant resembles those whose inflorescence is properly centrifugal; but differs, inasmuch as of several branches or secondary axes that which is lowest is often longest, bears most flowers, and is forwarder in their expansion than any of the branches of the same rank which grow above it. A source of error exists, however, in that while three or more branches rise to a level with the main axis, opening their flowers in a centripetal order as compared with each other, another branch or two may sometimes be found lower down which flower later, as following a centrifugal order.

It sometimes happens in the King-cup that there is more than one sub-terminal flower, each on a simple pedicel. It is easy to imagine the number of such flowers increased indefinitely. This conception is realized in the genus *Aconitum*. The lower branches of the stem in *Aconitum paniculatum* retain their terminal flowers and have also flowers at their sides, thus forming a real panicle. The main axis of the stem is not, I think, so constant either in the possession of or in the want of a terminal flower. In the common Monkshood (*Aconitum napellus*), neither the main axis nor any branch of the flowering stem is terminated by a flower, but sometimes even *A. napellus* reveals its affinity with plants having definite inflorescence by a pair of minute bracts on the stalk which bears a flower. This phenomenon is not, however, constant, nor perhaps frequent, but may be observed sometimes.

If we regard the King-cup (*Caltha palustris*) as representing the primary form of inflorescence from which other forms may have been evolved, it is interesting, in view of some recent speculations on the evolution of colour in flowers, to find the flowers of *Caltha* yellow and without petals, those of *Aconitum paniculatum* variegated with blue and white, while those of the Monkshood (*A. napellus*) are in an indefinite raceme, and of the deepest blue. *Ranunculus* differs from *Caltha*, and resembles *Aquilegia* in that the uppermost branch below the summit of the main axis is not a simple pedicel bearing a solitary flower, but a peduncle capable of branching and often actually giving origin to a lateral flower besides that upon its top; so that we find flowers on the primary, secondary, and tertiary axes, as in those plants which have a truly centrifugal inflorescence. Indeed, if the two uppermost branches of *Ranunculus acris* (the tallest Buttercup, which gives a yellow brilliance to fields where grass is growing to be cut for hay) were opposite, the order of expansion among the flowers of this plant would be really centrifugal, for the branches below these two are considerably behind them in the expansion of their flowers; but it sometimes happens that the uppermost branch but one expands its flower before that which is between it and the summit. This is the nearest approach to a centrifugal order of expansion without reaching it, or perhaps I should say without constantly maintaining it, that I know of.

Thus we see a gradation from the diffuse but definite mode of inflorescence observed in *Caltha palustris*, through the panicle of *Aconitum paniculatum*, to the indefinite spike or raceme of *Aconitum napellus*. On the other hand we see *Ranunculus acris* and other species of *Ranunculus* bearing considerable resemblance to *Caltha*, but with so much difference as to approach the centrifugal habit of *Silene*.

In the same natural order as the plants that we have been considering is the Traveller's-joy (*Clematis vitalba*), whose flowers are disposed in a manner so regular that we might regard it as the typical form of inflorescence with which other forms might be compared. In this plant the flowers are in a panicle, sometimes with a flower at the end of the main axis, which is however not often produced till near the end of the summer, when the flowers on axillary peduncles have given place to clusters of achenes with feathery tails. The leaves of this plant being opposite, so are the peduncles in their axils. The bracts which these peduncles bear are opposite as well, and each of them has a flower-stalk in its axil. So each axillary peduncle is the basis of a panicle, the flowers of which are arranged on the same plan which prevails throughout the entire flowering system. It is often not upon the top of a panicle that the first flower expands, but on one of the lower branches; then the flowering proceeds upwards as concerns the branches, but the terminal flower will be open before that of the uppermost branch. *Clematis vitalba* differs from *Caltha palustris* not only in its flowering branches being

opposite, like the leaves upon the stem, but in that the sub-terminal flower has a pair of bracts upon the stalk below the calyx which indicates the capacity of such a stalk for branching.

Panicles formed on the same plan as that of the Traveller's-joy may be found in the Privet, the Lilac, and other plants with woody stems.

Indeed, the panicle with a terminal flower in the centre, and with every branch ending in a flower under which lateral flowers appear in a series, which for the most part expand from below upwards (but with a reservation to the effect that the lowest flower of all is not therefore to be the first in opening), illustrates the general principle which is followed in the corymb and the cyme in the Pear, the Elder, and the Laurustinus as well as the Sweet William (*Dianthus barbatus*), by which this mode of inflorescence is brought into close affinity with the truly centrifugal system as commonly and correctly described in modern works of botany. The genus *Dianthus* differs from other genera of its order Caryophyllaceæ in having commonly two pairs of bracts under each flower; an arrangement which almost universally indicates an intermediate, or mixed, form of inflorescence as distinguished from either of those well understood systems illustrated by the Wallflower and the Campion, or by almost any plants of the orders to which these two respectively belong. In these plants in which characters resulting from a long career of development and differentiation appear constant and fixed, or only changing in specimens with abnormal forms, we see resemblances to the less constant modes of inflorescence found in the Monkshood and the Buttercup, from which we may be justified in the inference that the primary or normal form of inflorescence is to be found in the corymbs or panicles of apetalous Ranunculaceæ to which all other systems appear to be more or less nearly related.

Cordial votes of thanks were accorded to the authors.

At the Conversazione Mr. H. J. Barnes exhibited a fine collection of ferns from New South Wales, and Mr. R. M. Christy's collection of Primulas was again shown, want of time having prevented its due examination at the preceding meeting.

SATURDAY, DECEMBER 16TH, 1882.—ORDINARY MEETING.

The thirty-fourth Ordinary Meeting was held at the Head-quarters at seven o'clock, the President in the chair.

Donations of books and pamphlets (exclusive of "exchanges") were announced from Mr. R. Meldola, Rev. F. A. Walker, and Mr. W. Whitaker. Mr. English presented to the Museum a remarkable light aberration of the common Blackbird. Thanks were duly voted for these presents.

The following were elected members of the Club:—Messrs. J. D. Clay, Sydney Cortauld, H. W. Knowles, E. G. Law, Edgar T. Lockett, G. N. Maynard (*Curator of the Saffron Walden Museum*), F. C. J. Spurrell, F.G.S., John Stevens, and Thomas Taylor, M.R.C.S. (*Pres. Bocking and Braintree Nat. Hist. Soc.*).

In accordance with Rules III. and IV., nominations of new members o Council and officers for 1883 were made as follows :—

The following members agreed to retire from the Council :—Mr. W. C. Barnes, Mr. Herbert Goss, Mr. N. Powell, Rev. J. Francis, Mr. F. G. Heath, and Mr. J. P. Hore.

To fill the seats so rendered vacant, the following members were proposed for election into the Council, the proposals being duly seconded :— Dr. Cory, F.R.G.S., Mr. T. V. Holmes, F.G.S., Mr. John Hutchinson, Mr. Henry Laver, M.R.C.S., F.L.S., Mr. F. H. Varley, F.R.A.S., and Mr. W. White.

As *officers* for 1883 the Council recommended the following members: —*President*, Professor Boulger, F.L.S., F.G.S. ; *Treasurer*, Mr. Andrew Johnston, J.P., D.L. ; *Secretary*, Mr. William Cole ; *Assistant-Secretary*, Mr. Benjamin G. Cole ; *Librarian*, Mr. Alfred Lockyer.

The Secretary announced that the Council had authorized the sole use of the short title—" The Essex Field Club "—in future in all publications of the Club, in order to avoid misquotation and misconception as to the objects and scope of the Society. [See Trans., vol. iii., p. 1, *note*.]

Mr. R. M. Christy exhibited some shells of *Clausiliæ* for the purpose of calling attention to a supposed case of " protective resemblance " among Mollusca, and read the following note :—

According to the lists of indigenous Mollusca we have six species of *Clausilia* in this country, but two of these (*C. parvula* and *C. solida*) ought not, in my opinion, to be admitted. Of the habits of *C. biplicata* in this country I know nothing, but on the Continent it lives upon wet rocks. Of the remaining three species, *C. rugosa* may be described as very common, *C. laminata* as common, and *C. rolphii* as rare and local. It is a well-known fact that all three frequently live upon or under *Beech trees*. I have collected them all in such situations (the first two abundantly, and the last more sparingly) among the numerous clumps of beeches which fringe the northern edge of the South Downs. Now, the bud-cases of beech trees are in shape long and pointed, and in colour hazel-brown, thereby resembling very closely in these particulars, as well as in size, the shells of the *Clausiliæ*, so that at a glance the difference between the two might easily be overlooked, and it seems to me that there may be something in this fact more than mere coincidence. These sheaths or cases fall off the buds in spring, and throughout the summer thickly strew the ground below the trees where the *Clausiliæ* live among the dead leaves. I have brought specimens for exhibition, so that the resemblance may be the more easily seen.

The President thought that the resemblance was not sufficiently exact to allow one to say off-hand that it was a case of protective resemblance. Did Mr. Christy know whether birds were in the habit of feeding upon species of the genus *Clausilia*? The shells appeared to him as likely to prove very tough morsels.

Mr. Christy remembered finding a shell of one species in the gizzard of a blackbird.

The President, continuing, said it appeared to him necessary to show that this supposed resemblance was a protection from some enemy. He

might remind the members that there was a recorded instance of a caterpillar (the larva of *Lithosia caniola*) resembling a mollusc when coiled up among its food plant. Of course the use of the resemblance was obvious, as the rolled-up caterpillars had almost exactly the appearance in form, colour, and size of the shells, and the difficulty of finding them when thus feigning death was much increased. But in the case before them, although he was not disposed to admit it as an nstance of protective resemblance, still it was possible to look upon the superficial likeness of the shell to the bract as the raw material, so to speak, upon which Nature might work to produce a more exact and protective resemblance, should a change of habit of the enemies of the mollusc render such protection valuable.

Professor Boulger pointed out that several species of the Molluscan genus *Pupa* quite as much resembled the Beech-bracts as the *Clausiliæ*—indeed he failed to recognize any close resemblance whatever in Mr. Christy's examples. And to prove a case of protective resemblance we ought to be able to show a gradation, whereas we have no fossil species of *Clausilia* less like Beech-bracts than those exhibited.

Professor Boulger exhibited some large sections of woods, of German manufacture, showing transverse, longitudinal, and radial sections of the branch, designed for educational purposes. The specimens were about forty in number, and included all the British species of forest trees.

Mr. R. M. Christy read the following short paper, and exhibited specimens of the shells alluded to :—

Note on the White Varieties of Cochlicopa lubrica, C. tridens, and Bulimus obscurus.

Of all the many striking variations to which animals and plants are subject there are few of greater interest than those in which the usual colouring-matter of the species has, for some reason or other, not been supplied, leaving the individual pure white. This "Albinism," though fairly common among animals, is, perhaps, still more often met with among plants, but there is no branch of the animal kingdom in which it is more often seen than in the Mollusca; in the terrestrial forms especially a very large proportion of the species have varieties in which the shell is more or less pure white. Without desiring to enter into any general discussion on this subject (about which I am free to confess I know very little), I wish to record a singular fact which has come under my observation, and which I am totally unable to explain.

On the 26th of July, 1877, I was upon a certain ancient defensive earthwork of considerable extent, within twenty miles of Chelmsford (it is better, for obvious reasons, not to give the exact locality, but I shall be happy to inform any conchologist in private), when my brother, who was looking among the moss and roots of the grass for shells, discovered a specimen of *Cochlicopa lubrica*, var. *hyalina*, and a further search showed that this generally very scarce variety was far from rare there. Since that time I have paid many visits to the spot, and have always found the var. *hyalina* living in tolerable abundance, intermixed with the type-form which is rather the more numerous. This species often lives there among the moss and roots of the grass, but more often among the

fallen leaves and small twigs underneath the high hawthorn bushes which keep the ground below slightly moist. In the variety the animal itself seems to be of the usual colour, but the shell, instead of being a horny brown, is transparent, and coloured white with a tinge of green and a reddish apex. Specimens intermediate in colour occur, but are not common.

On a subsequent visit, on January the 18th, 1878, but in very mild weather, I discovered, at the same spot and all near together, three specimens of *Bulimus obscurus*, var. *alba*—another exceedingly rare variety, although the type-form is pretty common at the spot in question, and in other suitable spots throughout the county. I have not, since this visit, succeeded in finding more than one other specimen, and that a broken one, so I conclude it is very scarce there.

On April the 12th, 1879, whilst collecting specimens of the former variety, I obtained a single individual of *Cochlicopa tridens*, var. *crystallina*—another very uncommon variety of a shell which, though perhaps not rare in Essex, is certainly not common, and is only to be met with in a limited number of localities. On account of the similarity of the two varieties I did not discover what I had obtained until I had reached home, but, as I have never on any other occasion seen this variety there, I conclude that it is very scarce. The type exists in the locality, but in very limited numbers indeed.

This, then, makes altogether three white varieties of great rarity—in fact, so far as I am aware, there are not more than a dozen recorded localities for any one of them in England, yet here, on an area of ground covering less than half-an-acre, they are all three to be met with, and this fact suggests some interesting lines of enquiry as to the general cause of white varieties in Nature, and as to the special causes of the phenomenon in the present instance. Is it due to the lack of some particular constituent of the air or soil, or of the plants native to the place? And if some local peculiarity is the determining cause of the variation, why are not *all* instead only *some* of the shells white? The situation in which these shells live must be extremely dry, inasmuch as it consists simply of a high mound of earth with a moat round most of it. I may say that, of the other shells inhabiting this spot, some belong to species which are decidedly uncommon in the immediately surrounding neighbourhood, such as *Helix arbustorum*, *H. ericetorum*, *H. pulchella*, and its var. *costata*, *Pupa umbilicata*, and various others.

The President and Professor Boulger made some remarks upon the probable cause of white varieties in plants and animals.

Mr. R. M. Christy then read the following paper :—

On the Results of Interchanging the Eggs and Young of Different Species of Birds.

It is well known that our common English Cuckoo habitually deposits her egg, or eggs, in the nest of some small bird, and that the young Cuckoo is reared by the rightful owners of this nest with apparent willingness, and often to the exclusion of their own young. I do not ever remember to have heard of a case in which the foster-parents have refused to adopt the young creature thus unceremoniously thrust upon them, or one in which they did not display as much solicitude for its welfare as if it had been their own offspring. Although the nests of the Titlark, the Pied Wagtail, and the Whitethroat are those most commonly selected, yet there are perhaps as many as twenty or thirty species altogether which are recorded to have had, at different times, the

unpleasant task, as we should consider it, of rearing the offspring of another species. Some years ago the question occurred to me "How far may this sort of thing be carried?" and in the summer of 1876 I commenced a series of experimental interchanges among the eggs and young of the various common birds nesting near our house. This I did partly to satisfy a mere curiosity and partly to see whether I could throw some light on the willingness of one species to rear the young of another, as is the case with the young English Cuckoo and some other allied species. Of course in making these exchanges I had to take those obviously necessary precautions which I believe the Cuckoo itself invariably takes. Thus it would have been plainly absurd to place the egg of a Domestic Fowl among those of a Hawk or *vice versa*, or those of a Rook among those of a Partridge, and it would have been equally ridiculous to exchange the eggs of a Starling for those of a Tit or *vice versa*, or those of a Pigeon for those of a Thrush. In short I did not think it worth my while to effect any exchanges, either among eggs or young, unless the two species concerned approached each other more or less closely in regard to habits, food, and size. I may add that I never attempted to interchange the egg of any bird that is hatched fully formed, with its eyes open and able to run or swim and feed itself (called "Hesthogens," by Ed. Newman), with those of any other bird whose young is hatched, generally, in an elaborate nest in a tree, blind, helpless, naked, and unable to feed itself (styled "Gymnogens," by the same writer).

But few will need to be told that in one form this interchanging of eggs and young is a thing of everyday occurrence on any farm. The henwife thinks nothing of making a Hen hatch the eggs of a Duck, and even rear the aquatic young, while Turkeys may be set to rear young Geese without their expressing any particular objections. Every gamekeeper, too, is accustomed to place the eggs of the Partridges and Pheasants, that are mown over in haytime, under a hen to hatch. But there are cases on record in which this system of adoption seems to have been carried out voluntarily by both wild and tame birds. It is not very unusual to read of instances in which two different species have laid eggs together in the same nest. This seems to be more especially the case among some game birds than with others. Two Pheasants or two Partridges, or even a Pheasant and a Partridge, have not very unfrequently been known to do the same thing, while in Morris's 'British Birds' an extraordinary case is mentioned, in which a Common Buzzard, which had been kept some years in confinement, evinced, by constructing a nest of straw, a great desire for incubation, and on being supplied with Hen's eggs, sat upon, hatched, and even reared them. Doubtless a search into Natural History literature would reveal other instances, but I will here confine myself simply to recounting my own experiments.

My first attempt was on June 14th, 1876, when, finding a half-grown sparrow that had fallen from its nest, and was nearly dead with cold and hunger, I put it into a nest in which a Blackbird was sitting on four almost fresh eggs. On the 19th the Sparrow had grown and flourished famously, having been fed by the Blackbird at the expense of its own eggs, which, all except one, had disappeared. It left the nest on the 21st, as well as if it had been brought up by its own parents. At the end of the month I put some hard-sat Martin's eggs into a Swallow's nest in exchange for some of her own. They were hatched on the 4th of August, and successfully reared, as might have been expected from the similarity of the two species. At the end of June, 1877, I placed a Sparrow's egg in the nest of a Spotted Flycatcher, which afterwards laid some more of her own eggs without taking any notice of the stranger, but soon after the nest got taken. About the same time I interchanged a young Yellowhammer for a young Blackheaded Bunting. Both were

about half grown, and were reared successfully. On two occasions during July, 1877, I took a pair of Ringdove's eggs and placed them in a Stock-dove's nest, but both these birds easily forsake their eggs, and they did so in both these cases. About the middle of the same month I placed a Sparrow's egg among the eggs of a Sedge Warbler, and she continued to sit as before until someone disturbed her. On nearly the same date I placed a young Sparrow, just hatched, among some young Swallows of about its own age. It was reared, and flew about the 23rd. On the 28th I placed a young Sparrow in a Yellowhammer's nest with eggs. It was fed, and afterwards left the nest as usual.

About the middle of July, 1879, I put a Sparrow's egg into a Swallow's nest containing eggs. It was hatched about the 22nd, when the Swallows at once began to feed and attend to it, so that it left the nest a healthy bird about the beginning of August, but their own eggs became addled.

I may mention that my friend, Mr. J. B. Ellis, of Leicester, placed some Rook's eggs in a Magpie's nest in April, 1878, but only one was reared, and the young bird did not afterwards build at the same spot, as Rooks are said to have done occasionally when placed in Magpies' nests which happened to be built in a spot where it was desired to establish a Rookery.

This spring I made several more interesting exchanges during the months of May and June. About the middle of May there were in our garden two Greenfinch's nests—the one with five recently-hatched young and the other with five hard sat eggs. I effected a complete interchange between the contents of these two nests, and, strange to say, neither bird deserted. The one to which I gave the young must have been greatly puzzled to account for all her eggs having hatched during an absence of a few minutes only, but she took matters as they came, adopted the young, and tended them till they left the nest. Her perplexities must, however, have been as nothing when compared with those of the other bird, whose young had apparently, to coin an expression, *un-hatched* themselves back into eggs again; but, whatever she may have thought, she took matters contentedly, sat upon the eggs, which began to hatch next day, and the young were duly reared until they were nearly full grown, when some unknown person took them. A few days later I substituted four Sparrow's eggs for four Greenfinch's, in a nest in a hedge. These latter I put into another Greenfinch's nest close by that already contained four —making eight in all. I next substituted four fresh Sparrow's eggs for four hard-sat Greenfinch's eggs in a nest in our garden. These latter I put into a Sparrow's nest in a laburnum tree, taking the Sparrow's out and putting them, with others (twelve in all, about equally sat upon) into another Sparrow's nest in the same tree. Thus I had three Greenfinches sitting, respectively, on four Sparrow's eggs, on eight Greenfinch's eggs, and on four Sparrows' eggs; also a Sparrow sitting on four Greenfinch's eggs, and another on no less than twelve Sparrow's eggs. Just a week later I ascertained that every one of these experiments were going on satisfactorily—that is to say, the birds were sitting on the eggs I had supplied them with, and would have reared the young all right had not various circumstances happened to prevent. The first batch of four Sparrow's eggs before being hatched were sucked by a Cuckoo, while some of the second lot proved rotten; possibly I had chilled them in the removal. The eight Greenfinch's and the twelve Sparrow's eggs turned out to be, some of them, more incubated than others, and after the first young were hatched the other eggs were neglected and became chilled. The Sparrow hatched the four Greenfinch's eggs, and commenced to rear the young, but afterwards deserted them, perhaps on account of my disturbing her too often.

On the 15th of May I took two well-fledged young Starlings from their nest and put them into another nest in our garden, in which a Blackbird was just about to hatch four of her own eggs, which, however, she immediately left and confined her attentions to the feeding of the young Starlings. This she accomplished so satisfactorily that they left the nest on the 18th.

On the 22nd I put three very young Sparrows and three very hard-set eggs into a Greenfinch's nest, from which I took four hard-set eggs. I then took six hard-set eggs from a Whitethroat's nest and introduced four fresh Sparrows' eggs and a Greenfinch's. Next I extracted two out of six very hard-set eggs from a Marsh Tit's nest, and filled their places with two of the hard-set Whitethroat's. The result was that none of these exchanges proved a complete failure—all going on well for a time. Eventually, however, the Greenfinch, from some unknown cause, deserted the young sparrows, and I was unable to re-find the Whitethroat's nest with Sparrows' eggs. The Tits, however, hatched, and reared the young Whitethroats till they flew.

On the 21st of June I exchanged two young Swallows for two young Yellowhammers of about the same age. Two days after the young Swallows had disappeared from the Yellowhammer's nest, but whether they had jumped out or flown or been taken I do not know. The Yellowhammers in the Swallow's nest were fed, and went on all right, but several days after I found that one of them, then nearly full grown, had jumped out of the nest.

These experimental interchanges go far to show that one species of bird may be confidently relied upon to rear the young or hatch the eggs of any allied species, although this does not seem to apply to the Wood Pigeons.

On the motion of the President, a cordial vote of thanks was passed to Mr. Christy for his very interesting notes.

Professor Boulger then read a lengthy paper on the Rhizocarpeæ (a class of aquatic plants allied in some respects to the Club-mosses or Lycopodiaceæ), illustrating his remarks by the exhibition of numerous coloured diagrams and drawings specially prepared, and by means of dried specimens of the plants themselves.*

Some conversation having taken place as to the necessity for technical words in Botany, a cordial vote of thanks was accorded to Professor Boulger. The meeting then resolved itself into the usual conversazione.

SATURDAY, JANUARY 27TH, 1883.—ORDINARY AND ANNUAL GENERAL MEETINGS.

The thirty-fifth Ordinary Meeting was held at the Head-quarters at seven o'clock, the President, Mr. R. Meldola, in the chair.

Donations of books, pamphlets, and periodicals were announced from Messrs. J. Adams, H. J. Barnes, R. L. Barnes, Miss Cole, Dr. Cooke, Messrs. B. G. Cole, P. F. Copland, W. Emmens, W. White, and Mr. Searles Wood (papers and valuable manuscript and other geological

* This paper requiring a very extensive series of illustrations, and being in other ways outside the scope of the Club, was subsequently withdrawn by the author. It will, we understand, be published elsewhere.—ED.

sections relating to Essex). For the Museum, Essex birds from Mr. G. P. Hope. Unanimous votes of thanks to the several donors were passed.

The following were elected members of the Club:—Messrs. G. F. Beaumont, F. P. Hundley, and J. W. Russell.

The only business on the agenda paper was the consideration of the Bill about to be introduced into Parliament by the Great Eastern Railway Company for an extension of their Chingford line across Epping Forest to High Beach.

The discussion was opened by Professor Boulger in a vigorous speech, and he proposed the following resolution for the acceptance of the meeting:—

"That this Society, on behalf of the large section of the population of London, interested in the pursuit of Natural History, desires to record an emphatic protest against the proposal of the Great Eastern Railway Company to carry a line across a part of Epping Forest, believing that it is wholly unnecessary for the railway to take the route projected, and that it would not fail to prejudicially affect the advantages secured by the Epping Forest Act, which directs that the Forest is to be preserved as far as possible in its natural aspect; and the Society hereby authorises the Council to petition Parliament against the project, and to send copies of this Resolution to the Press."

Mr. F. H. Varley seconded the motion, and the discussion was continued by Sir Fowell Buxton, Mr. W. Cole, Mr. F. C. Gould, Mr. Varley, Professor Boulger, Mr. N. F. Robarts, Mr. W. G. S. Smith, and the President.

On the motion being put from the chair, it was carried amid hearty applause, with only one dissentient.*

In accordance with the circular dated January 15th, 1883, sent to all members, the Third Annual General Meeting was then held, Mr. R. Meldola in the chair.

In the absence of the Treasurer, Mr. N. F. Robarts read the Balance-sheet, which was unanimously adopted on the motion of Mr. John Spiller, seconded by Mr. F. H. Varley.

The Secretary read the Annual Report of the Council for the year 1882, which was also unanimously adopted on the motion of Mr. Henry Walker, seconded by Mr. T. Fisher Unwin.

No other candidates having been proposed, the new members of Council nominated at the last meeting on December 16th [see page xcii] were declared to be unanimously elected; and on the ballot being taken the officers then nominated were also declared duly elected by the Scrutineers, Mr. Spiller and Mr. Walker.

As Honorary Members, Professor Richard Owen, F.R.S., and Dr. Henry Woodward, F.R.S., were chosen by acclamation.

* Full reports of this discussion were printed in the 'Essex Times' and 'Chelmsford Chronicle' for February 2nd, 1883, and most of the arguments from the Club's point of view are given in the Introduction to Appendix No. 1.—Ed.

The President said it was his painful duty to announce that at the Council Meeting held on January 18th, it was resolved:—"That in accordance with Rule VII. the following members be removed from the Club, and their names read out from the chair at the Annual Meeting as having been expelled for non-payment of subscriptions, repeated application having been made for the same." [Here followed the names of eight members.]

In accordance with notice given at the last meeting, the Hon. Secretary proposed the abolition of the 7s. 6d. rate of subscription, on the grounds that the actual charge of each member upon the funds amounted to more than 7s. 6d., and further, as the operations of the Society embraced the whole county of Essex, the retention of the second class of members was felt to be unnecessary and anomalous.

The proposal was seconded by Professor Boulger, and passed unanimously. It was understood that the change did not legally affect members proposed previously to the last two months of 1883, but the hope was expressed that such members would accept the alteration for the reasons given above and in the Annual Report.

Some discussion took place as to the expediency of imposing an *Entrance Fee* of 10s. 6d. upon all future elections into the Club, but some doubts being expressed as to the wisdom of the proposal at that period of the Club's existence the matter was allowed to drop for the time.

The retiring President then delivered his third and valedictory Annual Address [Transactions, vol. iii., p. 59.]

At the conclusion of the Address, Mr. Henry Walker said that though the hour was then late they would not do justice to themselves unless they told their retiring President what was in their minds and hearts. They had come to that meeting feeling that it was a somewhat eventful night—the night of their parting with Mr. Meldola in his official character as President. It was not for him to attempt to give Mr. Meldola a certificate. But one could not help feeling this: they had all noticed the immense advantage it was to have in biological questions the assistance of one who had had what one might call a double training—a training in physical science, the severe training of the physicist. They had had that great advantage with Mr. Meldola; he had come to the consideration of biological problems with the enlarged views gained by studies in chemistry and observational astronomy. Unfortunately, so high an ideal as they had had before them made it somewhat difficult, perhaps, for a new President to follow, although he, knowing the succeeding President, could well assure the Club that he would fully vindicate himself. But he was then speaking only as their mouthpiece to convey to their President their very sincere regret upon his retirement; they were all under a personal debt of obligation to him, for they felt that the Club largely owed its status to him. He moved that the Club present its most hearty and sincere thanks to the retiring President. [Applause.]

Mr. Gould seconded the motion, which was carried by acclamation.

Mr. Meldola said he was deeply sensible of their kindly expression of feeling towards himself, and although he should not in future appear amongst them in a presidential capacity, he could assure them that the interests of the Club would always be in his heart, and that whenever and wherever he could possibly be of any service in forwarding their aims, he should always make it his pleasant duty to do so.

On the motion of Mr. Godwin, seconded by Mr. Hutchinson, a hearty vote of thanks was passed to the officers of the Club for their services during the past year, and also to the Auditors.

Mr. W. Cole and Mr. Lockyer having briefly replied, the meeting closed with the customary conversazione.

ERRATA.

Page 157, *note*, line 3 (from bottom), for *Euporbiæ* read *Euphorbiæ.*
,, xxxi, line 8 (from bottom), for *averne* read *averni.*
,, lx ,, 7 ,, ,, ,, *Sir R. Airy* read *Sir G. B. Airy.*

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APPENDIX.—No. 1.

PAPERS AND MEMORIALS
ISSUED BY THE ESSEX FIELD CLUB,

ON THE PROTECTION OF WILD ANIMALS AND PLANTS,
AND
THE PRESENT CONDITION AND FUTURE MANAGEMENT OF EPPING FOREST.

Edited by William Cole, Honorary Secretary.

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Price to Non-Members, One Shilling.

PUBLISHED BY THE CLUB.

BUCKHURST HILL, ESSEX.

1883.

" * * * * * * The throng
That dwell in nests, and have the gift of song.

" You slay them all! and wherefore? for the gain
Of a scant handful more or less of wheat,
Or rye, or barley, or some other grain,
Scratched up at random by industrious feet,
Searching for worm or weevil after rain!
Or a few cherries, that are not so sweet
As are the songs these uninvited guests
Sing at their feast with comfortable breasts.

" Do you ne'er think what wondrous beings these?
Do you ne'er think who made them, and who taught
The dialect they speak, where melodies
Alone are the interpreters of thought?
Whose household words are songs in many keys,
Sweeter than instrument of man e'er caught!
Whose habitations on the tree-tops even
Are half-way houses on the road to heaven!

" Think, every morning when the sun peeps through
The dim, leaf-latticed windows of the grove
How jubilant the happy birds renew
Their old melodious madrigals of love!
And when you think of this, remember too
'Tis always morning somewhere, and above
The awakening continents, from shore to shore,
Somewhere the birds are singing evermore.

* * * * * * * * *

" You call them thieves and pillagers; but know
They are the winged wardens of your farms,
Who from the corn-fields drive the insidious foe,
And from your harvests keep a hundred harms;
Even the blackest of them all, the crow,
Renders good service as your man-at-arms,
Crushing the beetle in his coat of mail,
And crying havoc on the slug and snail."

Longfellow.

PAPERS AND MEMORIALS

ON THE PROTECTION OF WILD ANIMALS AND PLANTS,

AND

THE PRESENT CONDITION AND FUTURE MANAGEMENT OF EPPING FOREST.

INTRODUCTION.

Among the many objects which may usefully engage the attention of a local Society of students of Natural History and lovers of Nature, none can be of greater importance, or more general interest, than the endeavour to check the wanton destruction of our native animals and plants, and by argument and example to retard as much as possible the effacement of the primitive conditions and features of the districts comprised within the sphere of its action. Much of the beautiful in Nature, in the vicinity of our large towns, has been ousted by the necessarily vast but too often reckless extension of buildings, while many a quiet garden, croft, or coppice has escaped the "jerry builder" and railway only to be clutched by the remorseless aërial demon of smoke, and blackened, choked, and withered as his own. We must, perforce, accept these evils as inevitable, until science and common sense shall, in the happy future, have abolished Erebus; builders and landlords shall have adopted honesty as the better policy; and tenants and tax-payers shall begin to think, speak, and act for themselves, demanding their rightful heritage of pure air, sound dwellings, and free space. We cannot check the builder or the auctioneer, and we are generally helpless puppets in the hands of the railway promoter. We must admire smoke since we so obstinately and wastefully refuse to consume or to banish it. But we can (and sometimes we do in a small way) control the birdcatcher, the fern and plant grubber-up, and the rowdy; and we may even yet induce game-preserving landlords and farmers to see the selfish error of their ways in classing all God's wild creatures as either "vermin" or "game"; the one section doomed to destruction in the gross that the other may be cosseted, guarded, and fattened for the mere pleasure of its destruction in detail.

It is in forming and leading public opinion in the direction of an appreciative and loving care for the wild beauties and free pensioners of Nature that we are convinced local scientific societies may do the state

good service. They can enlist both the philistine and the æsthete in the cause, for it has a decided material and utilitarian, as well as a sentimental, aspect, and even the "practical man" will, in this regard, admit its importance. In our own times we have heard of vast districts abroad perverted from their native fruitfulness into comparatively droughty wastes by the reckless felling of woods, the natural condensers and distributors of life-giving moisture. We have "game-preservers" persistently killing off the raptorial birds, and yet complaining that their grouse and pheasants are diseased, and that their tenant-farmers grumble at the increase of granivorous finches. We have poisoned our rivers and streams with factory refuse, and the air with soot and acrid vapours; with the result that the fishes are dead, and the suburban gardener mourns over his cankered roses and drooping lilies. These and a dozen other evils and evil practices, are not necessary concomitants of, but mere excrescences on, our modern life, and would soon be swept away were the true relish and love for pure air, pure water, birds and flowers, as deeply felt as they are freely written and prated about. To seek to foster and extend this love for Nature unadorned is a worthy ambition for a Club such as our own, and in most of the higher-class county naturalists' societies it has evidently been a prominent point in the estimation of their originators. Unfortunately the legitimate influences which associations of the kind might be supposed to exercise, have been too often allowed to fall into desuetude. In founding the Essex Field Club this idea was most distinctly kept in view, and great stress was laid on a rule of the Society relating to the preservation of natural objects and antiquities, the opening sentence of which runs as follows (Rule xx):— "The Club shall strongly discourage the practice of removing rare plants from the localities where they are to be found or of which they are characteristic, and of risking the extermination of birds and other animals by wanton persecution; and shall use its influence with landowners and others for the protection of the same, and to dispel the prejudices which are leading to their destruction." No apology is therefore needed for the publication of the following papers, and the Council believes that in placing the interesting and valuable statements of our members and others before the public in a collected form, it is fulfilling one of its most important functions, and establishing a firm *raison d'être* for the Club. The papers unavoidably appear as a somewhat disconnected series, having been issued at several distinct periods, and pp. ix. to xxv. have been in print for more than a year, although a large number of proofs of that portion of the pamphlet were distributed in the spring of 1882, as mentioned below.

The importance and pressing nature of the questions affecting the welfare of Epping Forest have necessarily led to the expansion of that section of the subject, but the Council of the Society is fully convinced of the great interest attaching to such an experiment as that proposed by Sir Fowell Buxton (see Report of Meeting held February 25th, 1882, page ix.), and is fully prepared to aid in carrying it out in any way that may be thought desirable. An edition of one thousand copies of the present pamphlet is being printed, and an endeavour will be made by placing them in the hands of those supposed to be interested in the subject to obtain the co-operation of at least a considerable proportion of the inhabitants of the parts of Essex in the immediate neighbourhood of the Forest. In the Forest itself, no shooting, trapping, or birds'-nesting is now allowed to be practised, and the good result is evident to all who have frequented it during the last few years; birds of all kinds are rapidly increasing, and certain species which were formerly confined to secluded parts of the woodlands are now spreading over the whole Forest, and this in spite of the vastly increased number of visitors.

The satisfaction with which the celebrated judgment of the Master of the Rolls of 24th of November, 1874, was received by those who for a long series of years had watched with hopefulness the attempts to preserve Epping Forest, was tempered by a latent fear that the Corporation would look upon the recovered land more as a park than as a tract of woodland to be retained in its primitive wildness and luxuriance. Gauging the opinion of the main body by the public utterances of some of its members, it was soon seen that the Corporation did not thoroughly appreciate the true nature and responsibility of the charge committed to it. Vast schemes of drainage, road-making, clearing, &c., were talked of as necessary and urgent "improvements," and a widespread feeling of uneasiness arose, second only to that which prevailed before the decision of Sir George Jessel. The writer ventured to put some of these fears into words, in letters to the public press in the year 1875, and to suggest plans of Forest management which have since been adopted and expanded by various writers.

These letters called forth a response from Mr. J. T. Bedford (a name to be always honourably associated with the rescue of Epping Forest), assuring the public that there was not the slightest intention of transforming "the people's Forest into a people's park," or of depriving it of any portion of its naturalness and sylvan charm. The "Epping Forest Act," which received the royal sanction on the 8th of August, 1878, seemed to afford, in its stringent language, additional securities for the integrity of the recovered Forest and its conservation as a woodland. But how little even the most definite promises and the strictest Acts of Parliament are to be trusted in matters affecting open spaces was abundantly shown during the years 1878—83. Roads and drains were made in every direction recklessly and without due consideration or knowledge; the quiet and rural Chingford was wilfully transformed into a bad imitation of Bartholomew Fair and Cremorne; while no less than three railway and tramway schemes, fatal to the best interests of the Forest, were pressed forward, two of them being vigorously encouraged by the very bodies to whose care and protection the woodlands had been confided by Parliament. We honestly believe that, had not public opinion spoken out on many occasions in firm and unmistakable tones, the schemes of spoliation and "management" put forward within five years of the passing of the Act would have degraded the place from a fine free open woodland into a third-rate park, and for ever extinguished its chief charm and value as one of the national recreation-grounds.

In accordance with the above views, and being impressed with the importance of Epping Forest as one of the finest districts for the study of Natural History in the county, the Essex Field Club has always consistently and vigorously protested against any schemes likely to injuriously affect it. In so doing the Club has acted also on behalf of the general public, the interests of the naturalists and ordinary visitors to the Forest being, as Mr. Meldola has shown, almost absolutely identical. Undoubtedly the most serious attacks on the integrity of the Forest were the three railway projects put forward during the period 1874—83, inasmuch as the evil effects of a railway are, from our point of view, so extensive, insidious, and irremediable. In the session of 1874 the Great Eastern Railway Company applied to Parliament for power to extend their Chingford line to Fairmead Lodge, near High Beach, a distance of two and a half miles across the Forest. This scheme was successfully opposed, and resulted in Parliament sanctioning an extension of about six furlongs, but so that the line did not enter the Forest at all. In 1877 a new bill was put forward for a line from Chingford to High Beach. This was rejected by the House of Lords, but was again introduced into Parliament in 1881, and supported with great energy by the Company

and by the Corporation. The bill was most strenuously opposed by all classes interested in the Forest. On January 28th, 1881, the Council of the Essex Field Club passed a resolution emphatically protesting against the scheme, and this protest was printed and very extensively circulated amongst scientific societies, the press, and the general public. On February 4th a deputation called together by our member Mr. F. G. Heath (who has always taken such a deep and active interest in all questions affecting open spaces) waited upon the Metropolitan Board of Works. The deputation (headed by Mr. F. Young, J.P., Chairman of the Epping Forest Fund) presented a memorial from various societies and individuals, urgently appealing to the Board for assistance against the projected mutilation of Epping Forest. At the meeting of the Board on February 11th it was resolved to petition Parliament, praying that no part of Epping Forest should be allowed to be taken for the purposes of a railway. A large number of petitions were presented to Parliament from metropolitan vestries, and from scientific and other societies, against the bill, and the press was almost unanimous in opposing it. Ultimately, in deference to these strong expressions of public opinion, the Great Eastern Railway Company decided to withdraw the clauses touching Epping Forest from the bill. But the spirit of spoliation was actively fomented by interested persons, and but short breathing space was allowed to the Forest defenders. Vandalism has, hydra-like, many heads, and a new danger threatened during the winter of 1881—2, taking the form of a Tramway Company's proposal to occupy the Forest-roads with its rails and tinkling cars! This precious scheme was, of course, recommended by the usual specious arguments, but in the opinion of all who took a really unbiassed interest in our grand open space it was only a degree less objectionable than the railway by reason of its comparatively temporary character, the removal of a tramway as a public nuisance being always possible, and indeed is, we believe, an incident not unknown in recent suburban local history. A strong resolution against the scheme and any interference with the natural features of the Forest was unanimously passed at a meeting of the Essex Field Club held on December 17th, 1881. Extensive circulation was again given to this resolution amongst societies, the press, &c., and the proposed tramway was almost universally condemned as hurtful and unnecessary. Fortunately the local boards of the parishes through which the tramways were to run strongly objected, and ultimately the promoters withdrew from the contest.

In view of these repeated efforts to destroy the quietude of the Forest, and of some alarming attempts at deep drainage by the governing body, the Council of the Club resolved on an endeavour to put such matters in a clear light before the scientific and general public. The discussion reported on pages ix.—xxi. was accordingly held, and the issue of the present pamphlet resolved upon. In June a "Conference" with the Verderers of the Forest also took place at Mr. Buxton's house at Woodford (see 'Proceedings,' vol. iii., page xxviii.). Proof copies of the report of the discussion were widely circulated, and the various Natural History Societies in and around London were invited to sign the following resolution or protest, drawn up by Dr. Cooke. Some of the larger London Scientific Societies (such as the Linnean, the Zoological, and the Entomological Societies) did not see their way to passing the resolution in their corporate capacity, but expressed great sympathy with the objects in view. Space will not allow us to print more than the names of the societies by which the resolution was adopted; but the Club holds signatures representing between *five and six thousand* students and lovers of Nature, and it is believed that this number could easily have been quadrupled had anything like a public canvass been attempted:—

"That this Society [*or* I, as a working Student of Natural Science], has [have] long viewed with anxiety the gradual extinction of the larger species of animals and plants, and of microscopical organisms, which inhabit the commons, woods, ponds, and pools in the neighbourhood of London, and we [I] desire most cordially to co-operate with the Essex Field Club in its endeavour to check, and if possible prevent, the drainage of Epping Forest and its neighbourhood, or the prosecution of any works which may tend to destroy or reduce the undergrowth, woodland, and small pools, or in any way interfere injuriously with the plants and animals which flourish in such situations; and we [I] hope that the efforts of the Club will be directed to the maintenance of the Forest in its natural condition."

This resolution was passed at special meetings of the following Societies, and signed by the Presidents and Secretaries:—

Burnt Ash Scientific Society.
Croydon Microscopical and Natural History Club.
Ealing Microscopical and Natural History Society.
East London Natural History Society.
Erith and Belvedere Natural History and Scientific Society.
Geologists' Association.
Hackney Microscopical and Natural History Society.
Haggerston Entomological Society.
Hampstead Naturalists' Club.
Hertfordshire Natural History Society and Field Club.
Highbury Microscopical and Scientific Society.
Highgate Microscopical Society and Naturalists' Club.
Lambeth Field Club.
New Cross Microscopical and Natural History Society.
North Middlesex Natural History Society.
Petherton Microscopical Society.
Quekett Microscopical Club.
Richmond Athenæum and Field Club.
Royal Microscopical Society.
South London Entomological Society.
South London Microscopical and Natural History Society.
Sydenham and Forest Hill Microscopical and Natural History Club.
West London Entomological Society.

Notwithstanding these repeated and weighty expressions of public opinion against any change in the Forest, its friends had still a fierce contest before them in opposing a renewed attempt, in the session of 1883, to obtain powers to construct a railway across Hawkwood Plain to High Beach. The project was almost identical with that withdrawn in 1881, but it was remarkable for the energy with which it was pushed forward by its professional and amateur promoters, no less than for the emphatic verdict pronounced against it by the press, the public, and Parliament. As the "Forest Fund" had been dissolved, and the "Commons Preservation Society," although appealed to, declined to take an active part in the fight until it was virtually won, the work of organising the opposition fell upon the Essex Field Club. A resolution similar to those above alluded to, passed by the Club, was adopted by nearly all the local scientific associations in and near London, and inserted in a large proportion of the metropolitan and provincial newspapers. Two large deputations appointed by the Club, but in reality including many scientific men representing various societies, and gentlemen speaking on behalf of the Commoners, Sunday Schools, the Clergy, and public interests generally, waited upon Sir John Lubbock at the House of Commons on February

20th, and upon Sir Henry Selwin-Ibbetson and Lord Eustace Cecil on March 9th. Sir H. Selwin-Ibbetson's reply was very valuable as expressing the opinion of the statesman best qualified to give an opinion as to the meaning of the Act of 1878, and the intentions of its framers. It was indeed an emphatic condemnation of the scheme and of any interference with the Forest.

In order to refute the many misstatements made as to the inaccessibility of the Forest from existing railway stations, and of the motives and arguments of the "Naturalists' Opposition," a *résumé* of the facts of the case was drawn up and a very large number of printed copies circulated (see page xxxii., *infra*). The matter was felt to be so serious that every exertion was made by well-known friends of the Forest to inform the public of the nature of the injuries likely to be inflicted upon it by the projected railway; a considerable number of petitions were presented to Parliament against the bill, and the verdict of the press was almost universally adverse to it—in the few cases where the contrary view was taken the writers being evidently insufficiently informed of the true state of affairs. The bill came on for the second reading on Monday, March 12th, when Mr. Bryce moved and Prof. Thorold Rogers seconded the following important amendment:—

"That this House, while expressing no opinion as to the propriety of making a railway to High Beach, disapproves of any scheme which involves the taking for the purposes of a railway of any part of the surface of Epping Forest, which, by the Epping Forest Act, 1878, was directed to be 'kept at all times unenclosed and unbuilt on as an open space for the enjoyment of the public.'"

After a most interesting discussion the bill was rejected by a majority of 148 in a house of 312 members, and Mr. Bryce's amendment was added to the resolution. And thus ends the story of the second rescue of Epping Forest from the hands of the spoilers. The hearty approval with which the press greeted the verdict of the Commons was an accurate index of the level of public opinion in the matter, and a sufficient justification of the energetic action of the "naturalists" and their friends. We understand that the resolution so emphatically affirmed by Parliament will act as a bar against the introduction of any bills dealing with the soil of the Forest, and we can only hope that such attempts will not be renewed. But the history of the past few years is not calculated to induce a feeling of security; the public must be the guardian of the integrity of the Forest, remembering always the wise and divine injunction given in the olden time—"What I say unto you, I say unto all, Watch."

REPORT OF THE MEETING OF THE ESSEX FIELD CLUB,

HELD FEBRUARY 25TH, 1882.

A meeting of the Society was held at the Head-quarters, Buckhurst Hill, at 7 o'clock, the President, Mr. Meldola, F.R.A.S., F.C.S., &c., in the chair.

After the despatch of the ordinary business of the meeting, in accordance with the agenda paper, the subjects of the protection of our native animals and birds from wanton destruction by gamekeepers, birdcatchers, and others, and of the management of Epping Forest and other "open spaces," came before the Club for discussion.

The Secretary read a letter from Sir T. Fowell Buxton, Bart. (one of the Verderers of Epping Forest), asking for the opinion of the Society as to "the expediency and the possibility of preventing the killing of all birds by keepers. No shooting is now allowed in the forest. It would be interesting to observe the effect after some years, and it would greatly add to the value of the experiment if the same rule could be observed throughout the valleys of the Roding River and Cobbin Brook."

The President pointed out the importance of the subject, which came so fully within the scope of the Society, and hoped that the question would be thoroughly discussed. It was hoped that Sir Fowell Buxton would have been present to start the debate, but he was unavoidably detained in another part of the country, and the President therefore called upon Mr. Andrew Johnston (also one of the Verderers) to give his views on the matter.

Mr. Johnston having explained the reason of Sir Fowell Buxton's absence from the meeting, observed that he could say but little about his brother Verderer's views, as he had had no special communication with him on the subject, and further he (Mr. Johnston) was not a naturalist, and had only considered the question in the most general way. A very strong feeling had been growing up of late years in favour of giving Nature freer play, and preserving wild animals and birds from wanton destruction, not only on account of their interest to the naturalist and lover of Nature, but also from motives of humanity [hear, hear], and it certainly seemed to him that there was a grand opening for trying such an experiment as he understood was proposed by Sir Fowell between the valleys of the Roding and the Lea, seeing that in that area there were 6000 acres of forest land, the governing body of which had forbidden the slaughter of any animal or bird, with one exception, the trapping of jays. He believed that exception was contrary to Sir Fowell Buxton's ideas, but the destruction of the jays was allowed to be continued on the

suggestion of Mr. E. N. Buxton. Mr. Buxton was strongly possessed with the idea that if jays abounded other song-birds would go off, because jays were the greatest robbers of nests. Of course, the obvious answer was—well, let everything have free play, and the jays will be kept down by their natural enemies, or by the absence of food, to their proper proportion. [Hear, hear.] On the other hand it might be urged that birds of prey were kept down by game-preservers to such an extent that a hawk was looked upon with as much wonder as an elephant [laughter], and as for an eagle, such a bird was now rarely seen in England. Mr. Buxton had the majority of the Conservators with him when he proposed that jays should be trapped, not shot; they very rightly considered that the firing of guns should be entirely abolished within the limits of the forest. Therefore, if any members of the Club heard the report of a gun in the woods, they might be perfectly certain that it was unlawfully fired in direct defiance of the bye-laws, and they should try to ascertain the name of the offender and forward it to Sir Thomas Nelson. He thought that Sir Fowell Buxton's idea was that some kind of agreement should be come to between the various landowners, occupiers, and owners of shooting in the district. Of course they might shoot game, but he supposed it would take the form of agreeing not to shoot birds of prey. Whether anything could be done effectively in that direction he could not say. Sir Fowell himself was probably the largest landowner in the district, except Mr. Maitland; there were then Mr. Edwards, of Beach Hill, and others Sewardstone way who might be brought in. Sir Fowell Buxton had mentioned to him that Lord Leicester, the largest landowner in the county of Norfolk, had resolved to stop the killing of birds of prey on his estates, although he had a great deal of game. He also knew that Mr. Gurney had given orders to his keepers not to destroy birds of prey. Whether the keepers obeyed the orders was quite another thing [laughter], but he believed this was decidedly Mr. Gurney's wish. There was only one other point to which he could allude with any benefit, and that was as to the ubiquitous sparrow. Colonel Russell, of Stubbers, had for many years waged a most desperate war on sparrows, his desire being to protect the martin from their ravages. He had been most extraordinarily successful. He found that the martins were almost disappearing from the country. On his house their nests, which had been numerous, were reduced to two, and he found that the reason of this was entirely that the sparrows took possession of the martins' nests, and, being the stronger birds, drove them out. He set to work to destroy sparrows in every possible way. He laid lines of grain for them and shot them; and he shot them while they were actually trying to take possession of the nests, using a very small charge of powder so as not to destroy the nests. He gave rewards to boys and gardeners and everybody about the place to destroy the sparrows. He began about a dozen years ago, and the first year his two nests increased to seven; the second year to 23; the third year to 47; and the last time he (Mr. Johnston) was at Stubbers, which

was a great many years ago, it was a beautiful August morning, and there was a splendid cloud of martins and swallows flying over the house at the time. Colonel Russell had now got—he thought he told him 130 nests on the house; certainly some very large uumber. Therefore he thought the sparrow must be, as Macaulay said in those days of the Papists and Quakers, "beyond the pale of the widest toleration." [Laughter.] Some people were sanguine enough to believe that the stoppage of the destruction of birds in the Forest by the London bird-catchers would greatly encourage several rare birds, which had now almost disappeared, to breed again in the woods. There had been quite an influx of nuthatches at Mr. Barclay's, at Monkhams, Woodford. It was not, Mr. Johnston believed, at all a common bird. Mrs. Barclay was accustomed, as he was, to hang out tallow candles for the tomtits in winter, and the nuthatches had assaulted the candles. Then she put out nuts, and it was most extraordinary the quantity of nuts they had carried off. They were found stuck in the grooves of the bark of a semi-deciduous elm, where the birds hammered away at them and then ate the kernels. Mr. Johnston concluded by expressing a hope that Sir Fowell might be able to come on some other occasion to make some practical proposals as to the means to be adopted in carrying out his scheme.

The President thought the subject which had been brought forward was one which, as a Natural History Club, they had every right to consider, and he was very glad to see that they had among them several gentlemen who were well able to give valuable assistance in discussing this question. They had Mr. Harting, than whom no one was better qualified to discuss the question of the preservation of birds; and he thought that they might very well enlarge the sphere of the discussion, and not allow an opportunity like that to slip for discussing the question of the preservation of smaller game. He thought the question should be discussed on broader grounds than the preservation of the vertebrate fauna, and the presence of Mr. Johnston, one of the Verderers of Epping Forest, was an occasion which should incite them to discuss the question with all the vigour they could, from the naturalist's point of view. They had with them that evening Dr. Cooke, than whom, perhaps, no greater authority on pond life was to be found: he had worked the district himself, and must have a great deal to tell them.

Mr. Johnston interposed to state that he was obliged to leave the meeting, having another engagement, but he thought that if any communication from the Club were sent to the Conservators of the Forest, it would receive the greatest attention, and that they would be obliged and thankful for any hints. They were not a body appointed for their knowledge of Natural History, but anything that came authoritatively and officially from the Club would probably receive every consideration.

Mr. Gould—Before you go, Mr. Johnston, I should like to ask how the jays are caught; what kind of traps do they use?

Mr. Johnston—I really cannot say. I have not happened to come

across any of them, and as a matter of fact I believe very few jays have been caught. [Laughter.]

Dr. Cooke said that when he heard of this subject being brought before the Club it struck him as an excellent opportunity to nudge the elbows of the Conservators, and tell them a little of what they as naturalists thought about the conditions under which the protection of public property was being pursued, not only in Epping Forest, but in other places, to the great detriment of those individuals who went puddling in dirty pools to find something to study under the microscope. It was a complaint which had been urged in every instance in which any amount of land had been conserved for the use of the public. In every instance it had been to a large extent destroyed for naturalists, especially those who devoted themselves to the study of minute life. The reason of this might perhaps be traced to ignorance on the part of those who had the control of these works rather than to any wish to injure the wild animals of minute dimensions. They did not measure by inches and feet the animals whose cause they had to advocate. [Hear, hear.] He was not about to propose that they should go to Parliament for a Bill for the Preservation of Bugs and Beetles. [Laughter.] But he did propose that they should try to prevail upon gentlemen who were placed in the position of Mr. Johnston —he was sorry that he should have been compelled to leave before he could whisper a word in his ear—he thought they should try to give them some little information about the work that was being done. To come down to detail. The organisms that he specially advocated were those which were as small, or smaller than a pin's head. These were the organisms that were most injured by the usual plans for the preservation of land for public purposes. They were also the class of organisms which were now exciting the greatest amount of interest among naturalists, who were seeking to solve the problem of life very much through the study of the life-history of the lower and more minute forms. And hence every minute organism which was found in a puddle might teach a great lesson [hear, hear], and a lesson which we could not learn by staring at a lion or rhinoceros. There were in London, as well as in Essex, a large number of people associated together in societies for the study of forms of microscopical life. He had the honour to be the president of one society of 200 members, and the vice-president of another which contained over 600 members; and the general feeling amongst those, nearly a thousand individuals, was that every year they had to go further from London in search of the organisms they studied. The excursion parties of the Quekett Club had found it no longer of any use to go to Wimbledon Common in quest of minute life—the place had been given over to the tender mercies of the volunteer and drain-maker. Hampstead Heath was another instance—and a very good instance—of a heath which had been preserved for the benefit of the Cockney; but it had been now nearly destroyed for the purposes for which the London naturalist particularly desired it to be preserved. Then Battersea was a third

instance, while, if they went to Birmingham, Sutton Park was preserved to the people for ever, but the same work of destruction was going on, and it would quickly lose its charms for the naturalist. Dr. Cooke went on to point out the directions in which this destruction and this injury were being done. We had, he estimated, altogether about 300 species of fresh-water Algæ. We had in addition about 200 different species of Desmids, and many other forms, all of them inhabiting still waters, and many of them stagnant waters; a large number of fresh-water Diatoms, not forgetting such plants as *Drosera*, which loved damp, mossy spots. Then in animal life we had at least 250 different kinds of Infusoria, and Rotifers which must be put down at not less than 150. Altogether there were about 1200 species of minute life, of which about 600 were vegetable and 600 animal. At a very moderate estimate he should say that they were able to find 500 species of minute life within Epping Forest. He had been looking over the work published by Dr. Hassell fifty years ago, and found that he enumerated about 25 species of fresh-water Algæ, which he found for the first time, or nearly for the first time, in Epping Forest, or within a few miles of Epping. He (Dr. Cooke) was able to bring that number up to about 50, and he had only searched for them one afternoon, and even then he had not gone beyond Wanstead Flats; so that if he estimated they would find 100 species of fresh-water Algæ in Epping Forest he was understating the fact. These plants only grew where the water was still and stagnant, as in those little pools which were so common on Wanstead Flats, and other parts of the Forest. But, judging from appearances, the aim and object of the Conservators and those in charge of such lands was, by deep drainage, to destroy all these pools. [Hear, hear.] Everywhere, at all times and in all places, it appeared to be imagined that the Easter Monday Cockney was the person to be looked after and petted most carefully, and a dread was felt that these tender people would mud their boots if they came in search of recreation and found the Forest in its natural condition. [Laughter.] He thought that these individuals were not to be consulted in their (supposed) peculiar tastes and habits entirely and absolutely. The Conservators ought to strive to maintain the vegetable and animal life on the lands committed to their charge, and it could be done without any injury to the purposes for which the Forest was preserved. He thought it was perfectly clear that there was quite room enough round the various public-houses for the people who came down there on special days set apart to make a John Lubbock's day. The condition of the outer tract would not interfere with *them*. He had been down to the Forest on holidays, and he had never found the irrepressible Cockney beyond some ten minutes' walk from the public-house. [Laughter.] But he found the members of the Quekett Club with their bottles, and the entomologists and botanists with their nets and vasculums, in the depths of the Forest, never much regarding whether they got mud over their boots or not. His object was to protest against the Forest being served in the way Hampstead Heath had

been ruined by the Metropolitan Board of Works. Twenty years ago he used to see the wondrous and beautiful little "Sundew" (*Drosera rotundifolia*) at the back of Jack Straw's Castle. It had disappeared; and he was told that since the drainage of parts of the Forest, and since there had come into fashion a rage for insectivorous plants, inciting the irrepressible Cockney to seek it out for his own purposes and advantage, that *Drosera* had disappeared from many spots. *Sphagnum*, and a large number of other interesting things, had also been "improved away" from Hampstead Heath, so that for the purposes of the humble and earnest student of minute life the Heath had been spoilt—everything worth seeking for had been killed off by the system of drainage. It was to protest against that, and to lay the true facts of the case before the Verderers and Conservators of the Forest, that he had spoken. They hoped to obtain for the smaller beings that protection which was happily now, in some measure at least, granted to wild birds and ancient monuments. They asked that the Conservators should consider the scientific Cockney as well as the Easter Monday Cockney in their preservation of Epping Forest. [Loud applause.]

Mr. Harting said it was impossible not to approve the principle which was involved in the proposition that Mr. Johnston had made on behalf of Sir Fowell Buxton, and he was sure it would commend itself to every sensible and humane person. On reading the circular he had been under the impression that the proposition to be considered was whether some application to Parliament should or should not be made to bring about so desirable an object. It seemed, however, from what Mr. Johnston had told them, that that was not the intention of Sir Fowell Buxton, and that his proposition was rather to make an experiment in this county only; it was to ask landowners in that particular district between the rivers Roding and Lea to instruct their keepers to abstain from wantonly destroying certain birds. Mr. Johnston had, he noticed, referred only to the birds, and had said nothing of the smaller Mammalia. A good deal of this wanton destruction was due partly to prejudice and partly to ignorance on the part of the keepers, and it seemed to him that that Club might do a great deal of good in the way of instructing keepers, and in helping to remove the ignorance which at present prevailed regarding the habits and food of those species of birds and mammals which were to be met with in the district referred to. The Society, for instance, might appoint a committee of specialists, and invite each member of the committee to put on paper his ideas with regard to those species in his own department which were likely to be found in the neighbourhood. It was almost hopeless to expect that game-preservers would instruct their keepers to allow stoats and weasels and polecats to have the run of the place; being carnivorous animals they could not subsist without preying on some of the creatures which it was the very object of game-preservers to keep alive. With regard to birds, no doubt there was a great deal of prejudice against hawks and owls. Against some of the species no doubt

a true bill had been found over and over again. Their natural instinct prompted them to take winged game, but on the other hand, many of them destroyed a vast number of rats and mice, which would otherwise unduly increase, to the farmers' prejudice. He thought, as there was no particular hurry about this matter, the Society might consider whether it would not be desirable to put forward some little pamphlet on the subject of the mammals and birds which it was desirable to preserve in that district by way of experiment, and have the pamphlet properly circulated. He believed that a great deal of good might be done in that way. He fully sympathised with Dr. Cooke's regret at the destruction of his "happy hunting-grounds": at the same time he thought they ought to consider the other side of the question a little. One would like to know whether the deep drainage system, while it utterly destroyed the little pools that were so fruitful for the microscopist, did not improve, or, at all events, preserve from perishing, the forest trees. If deep drainage was positively beneficial to the trees, he thought they must not sacrifice the trees for the sake of the pools which Dr. Cooke had dilated upon with such zeal. But that was a question, of course, for the Conservators. They would no doubt have their reasons to give for the system of drainage which had been adopted.

The Rev. W. Linton Wilson said—Mr. Johnston had promised that if they put a proposition before the Conservators it would receive consideration. Dr. Cooke had put a proposition before the Society, and Mr. Harting had enlarged upon it and brought it to bear on the mammals and birds. They ought, he thought, to put what they meant into some shape that the Conservators could understand, and forward a resolution with it. The matter was now somewhat ripe. They had been considering it ever since the Club started, for he remembered that the President made a very able beginning of the discussion in his first address; and he thought, with the gentlemen they had there, they were quite able to put the matter into the form of a resolution which the Conservators would understand. For his own part he would allow everything to have free play. [Cheers.]

Mr. Gould did not believe in disturbing the balance of Nature. His opinion was that there were still a large number of birds of prey in the Forest. With regard to the jays, there was no doubt that jays were great robbers, but he would be very sorry to see their extermination. [Hear, hear.] It might not have a very musical voice [laughter], but it was one of our most beautiful birds for colour, and he should be very sorry for its destruction. He thought things would go on very much better if everything were allowed to have free play. [Hear, hear.] He did not at all sympathise with what Mr. Johnston had said about the sparrows; he did not see why the sparrows should not have as much chance as the martins. [Hear, hear.] The sparrow stopped with us all the year round, but Mr. Martin went away when it got cold. [Laughter.] After expressing his regret that Sir Fowell was not present, because being one of the largest game-preservers near the Forest he could have been of great service to the

Society, he referred to the bird-trappers, and said that it seemed to him that some amendment in the law was required. As to the Wild Birds Protection Act, it was simply a farce. Bird-catchers came into the Forest in close-time, and nothing could be done to them, because if they were caught they would declare that they were catching birds which were not protected. The only way to put a stop to this kind of thing would be to have no exceptions whatever, but make it penal to catch any birds at all, and to give powers to the police to confiscate the bird-trapper's nets and cages when any man was seen with them at improper seasons. [Cheers.]

Mr. White, referring to a statement made by Mr. Varley that he had planted *Nitella* in some ponds at Whipps Cross, condemned the introduction of non-native plants, and went on to say that from some of the speeches made that evening they would come to the conclusion that they ought to protect the majority of creatures, but to destroy some others. He argued against this view, and in favour of giving Nature full and free play.

Mr. Godwin remarked that Mr. Harting had seemed to be in some doubt as to whether drainage was or was not injurious to the forest trees. Perhaps some botanical member present could state the effect of drainage upon the growth of trees.

Dr. Cooke replied that there was no doubt but that the presence of stagnant water, water standing round the roots of trees, was injurious to forest vegetation. But unless the trees were growing in a water-logged soil, his experience was that they were not injured. The soil might be as damp and as heavy as you please; so long as it lay on a slope, so that the water did not become stagnant about the roots of the trees, no amount of moisture was injurious. And that brought them back to the suggestion of Mr. Harting—suppose the Conservators were doing this for the benefit of the trees? They wished the trees to be better than they were a thousand years ago. It was supposed that at that time the forest trees grew pretty successfully—[laughter]—in Epping Forest when there was no deep drainage; and they had continued to do so down to our own time. It was only lately that the trees had got into such bad habits as to require under-draining to make them grow better. [Laughter.] Really the fault was that Conservators of such places wanted to make them into parks. [Hear, hear.] It was against that he protested. He liked wild Nature. [Cheers.]

Dr. Pearce spoke of the process of under-drainage having been stopped in Kensington Gardens because it had been found that it killed the trees. [Laughter.]

Mr. Unwin thought that the Conservators were not the Philistines that some would make out. They were open to reason, and would be willing to consider anything that the Society could put before them. How best could they put something before them? He thought they should ask their members who were specialists, Mr. Harting, Dr. Cooke, and one of their botanists, to put down, in a short concise paper, what they required

from the Conservators. Then if those papers were brought by the Secretary into one memorial from the Society, the Conservators would consider it. Perhaps, also, it would forward their ideas to publish a paper on the same grounds for the benefit of the keepers, showing them what was wanted, not only by the Society, but by the larger and equally interested society represented by London and its neighbourhood. He also suggested that the memorial to be sent to the Conservators should be brought before the different scientific societies of London and the scientific Press, because their influence was much greater upon corporate bodies than was sometimes supposed. He moved, therefore, that the Council be requested to prepare a memorial for submission to the next meeting.

The President said it seemed to him that they were pretty unanimous in agreeing that the Forest should be interfered with as little as possible. [Hear, hear.] And in fact it seemed to him that that was really what the Verderers equally desired. According to the Act of Parliament the Forest was to be preserved as nearly as possible in its natural condition. It was not a natural condition for the Forest to be deeply under-drained. [Hear, hear.] The question, of course, from the point of view of the pure naturalist, was a very broad one, and many of the speakers had made remarks with which he cordially agreed. The animals and plants of any country were there by virtue of adjustments which had taken many ages to bring them to their present state, and every interference on the part of man led to a long and endlessly complicated chain of results which no person could foresee. That seemed to him a very strong argument for leaving Nature alone as much as possible. He thought the best thing would be to appoint a sub-committee of specialists who should put into writing their views as to how the Forest should be dealt with from their point of view. Of course that would be a work requiring some little time for preparation. By way of preliminary he thought it would not be a bad thing if a full report of the discussion were printed and sent round to the various scientific papers. In that way Natural History societies throughout London and the country generally would see that they had taken the initiative in this very important question.

Mr. Wilson seconded Mr. Unwin's proposition, and added that they should not forget one remark made by Mr. Johnston when he said that landowners gave orders to their game-keepers; but whether the game-keepers obeyed them or not was another matter.

The President thought a circular should be sent officially from the Club to the landowners, asking them to assist in the experiment.

Mr. Godwin suggested that, if the report of the discussion and the proposed special statements were printed and sent to the Conservators, copies should also be sent to the landowners.

Mr. Gould asked whether they might not also include some reference to the shooting of the deer in the Forest. Mr. Johnston said that no gun was allowed to be fired in the Forest; but they had read very glowing

accounts of the shooting of the deer in the Forest last year, and he believed some of them were found wounded two or three days after. If it was necessary for natural reasons, or for Corporation reasons—[laughter]—to kill one or two of these deer, it should be done in a proper and workmanlike manner, and not by making a battue of it. [Cheers.]

Mr. R. L. Barnes asked if it was a fact that nothing could be done under the Wild Birds Protection Act?

Mr. Gould—Nothing is ever done.

Mr. Barnes—But can nothing be done? If there can, the Act ought to be put in force wherever possible.

Mr. Gould—We should have to make ourselves into special constables to watch these men. [Laughter.]

Mr. Harting stated that, with regard to the Wild Birds Protection Act, some gentlemen seemed to be under the impression that only certain birds were protected, but in reality from the 1st of March to the 15th of August all birds were protected. For catching those birds mentioned in the schedule a penalty not exceeding £1 could be imposed, while in respect to those birds not mentioned in the schedule the penalty did not exceed 5s. and costs. Owners and occupiers, however, had a right to authorise persons to kill birds on their own land; and this exception to the general rule opened a very wide door, and left matters pretty much in the same state as they were before the passing of the Act.

Mr. Unwin suggested that the Secretary should call the attention of the Chief Constable of the county to the provisions of the Wild Birds Protection Act, with a request that he would give his subordinates instructions to rigidly carry out the Act.

The Hon. Secretary thought it only right to explain that the Verderers had in themselves no power over the Forest, inasmuch as they were only members of the Epping Forest Committee, and were of course in a hopeless minority. He might mention that all the Verderers were members of the Essex Field Club, and were in favour of the movement which had been advocated that evening.* He read some letters he had received from members of the Club who were unable to be present.

* Under date March 7th, 1882, Mr. E. N. Buxton (Verderer) wrote to the Secretary as follows, referring to the proceedings at the meeting:—"I can only protest against the view which seems to be entertained by some members of the Club, that the Conservators are indifferent to the natural features of the Forest. As far as the *Verderers* are concerned at any rate, the reverse is the truth. In many respects the Forest is at present in a non-natural condition. I for one desire to restore the natural state. This cannot be effected, for instance, by allowing the *pollard trees*, which I suppose nobody would describe as a natural product, destroying, as they are doing, the comparatively few natural grown trees, and also all the natural undergrowth. That is only one instance that might be cited. I admit that some things have been done of a formal and non-natural character. Some have been unavoidable; others were contrary to my desire and advice."—Ed.

Colonel C. Russell, J.P., D.L., &c., of Stubbers (the well-known Essex sportsman), wrote as follows:—

"My view of the birds of prey question is that in the absence of man some of these birds would destroy all the increase of birds useful to him, so he reasonably kills the former on the same principle as he would wolves. In this country, however, it seems to me that the destruction of birds of prey has been overdone: the whole class is being exterminated, whether injuring or not. I believe that the owls are almost entirely harmless, and indeed very useful; and that, as a general rule, the hawks still remaining here might without detriment exist in much greater numbers than at present.

"No doubt hawks will sometimes take to destroying young pheasants where they are reared in numbers, and some of them might take young fowls; but if landowners would forbid the destruction of hawks (especially kestrels), except in cases where they are doing mischief, I believe that they would suffer no perceptible loss.

"With regard to the white owl, the most harmless and useful of our birds of prey, the only accusation seemingly well founded against it is that it destroys young pigeons. I have heard equally good evidence of the owl nesting in a pigeon-house without doing any harm to the pigeons. The discrepancy very likely depends on this—where the owl is a stranger, the pigeons all fly out when he comes into their place, and the small young ones being unprotected, I see no reason why the owl should not eat them. On the other hand, if the pigeons disregard the owl and keep on their nests, I believe that he will not interfere with them. If this view is right, it might not be a bad plan for anyone who likes both owls and pigeons to keep a tame owl in his pigeon-house through the winter.

"Poisoning rats and mice in out-buildings is likely to destroy owls, as the poisoned animals often creep about outside in a feeble state. This is one difficulty, as farmers now poison rats and mice to a great extent; and there are many others in the way of preserving, in a country like this, those beautiful and interesting birds, hawks and owls; but it is much to be hoped that something may be done in that direction." *

Mr. E. N. Buxton, J.P., D.L. (one of the Verderers of the Forest, and Chairman of the London School Board), wrote as follows:—"I am glad to see that you propose to discuss the question of protection to birds. There is one measure which I believe to be most important for the existence of the small birds in the Forest, whether natives or migrants, and that is the limitation of the number of their natural enemies, the

* In a subsequent letter (March 28th) Colonel Russell remarks:—"As to the *Jays* I should feel inclined to let them alone, at any rate for a time, if only to find out by experience how far they affect the numbers of other birds, and what kinds suffer most from their depredations. There will be a good opportunity of making such experiments in Epping Forest, and it should be very interesting to naturalists in the neighbourhood to observe the results. I have noticed, that when a wood pigeon is frightened from its nest in a place frequented by jays, that the eggs always disappear, probably being eaten by the jays before the return of the pigeon. Owls, especially white owls, would be very useful in the Forest; they rarely catch birds, and they keep down mice, which not only often destroy small birds' eggs, but bring stoats and weasels, which are most destructive to young birds, climbing up bushes and trees to take them from the nests. If there are not plenty of old trees with holes in the Forest, it would be well to put up boxes for owls, and also for small birds. I find that titmice and redstarts will avail themselves of such accommodation freely."—Ed.

Jays. They are utterly destructive of the nests of all birds which do not build in holes, and the condition of the Forest being very favourable to them, they are multiplying exceedingly. The Conservators do not allow keepers to use guns,—quite rightly, I think,—and although they have permitted traps for the purpose of catching the jays, I do not think the keepers are much up to this kind of work. I think it would not be amiss if the Club would make a suggestion on the subject. I would gladly have attended the meeting on Saturday if I were at home, but I shall be elsewhere."

Mr. W. Saville Kent, F.L.S., F.R.M.S. (author of the 'Manual of the Infusoria,' and late Naturalist to the Brighton Aquarium), wrote:—"Although I cannot be present with you in person to-morrow afternoon, I *most thoroughly sympathize* with the object of your meeting; and most sincerely trust that your meritorious efforts to abate the present wholesale extermination of our indigenous animals and plants, and destruction of notable habitats, will meet with the success they so richly deserve. The reward which has attended your exertions on behalf of Epping Forest must, I am sure, prove an incentive to further efforts; and I greatly deplore that such a Society as ours was not in existence to interpose its ægis in the defence of Hampstead Heath, and half-a-dozen other localities I might name, once the 'happy hunting grounds' of the zoologist, botanist, and microscopist, but now converted by *deep drainage* and other barbarous 'improvements' to barren wastes."

Letters of sympathy and regret at enforced absence were also read from Mr. D. J. Morgan (the newly appointed Verderer in the place of the late Sir Antonio Brady), Mr. E. G. Varenne (of Kelvedon), Mr. Henry Laver, F.L.S. (Hon. Secretary to the Colchester Natural History Society), and others.

After some further discussion,

Dr. Cooke offered to write out his views, and the reasons for those views, to be laid before the Conservators. Before doing so, he would bring the subject before the two societies with which he was connected, which were principally interested in microscopical life, and would ask each of them to forward a resolution to the Essex Field Club; and then fall back upon those two societies, and ask them to supplement it by memorials of their own. He thought there was no doubt that from both of those societies he should be able to get strong protests against the destruction of the natural conditions of life in the Forest and elsewhere.

It was agreed that a memorial should be drawn up in accordance with the views expressed at the meeting, and that, when printed, copies should be sent to the Conservators, to landowners, to game-preservers, and to the Press. With this understanding the discussion terminated.

[In accordance with the above resolution, the three following memorials have been prepared by members of the Club specially acquainted with the matters in question. Dr. Cooke speaks as a student of minute life, and

as one of the first European authorities on the Cryptogamia; Professor Boulger as a botanist and forester; and Mr. Harting, Editor of a leading biological magazine, as a naturalist and sportsman, in support of the claims of our native animals and birds to the protection of all humane and patriotic persons.—Ed.]

I.

The Evils of Deep-drainage from the Naturalist's point of view.

By M. C. Cooke, M.A., LL.D., A.L.S., &c.

Many of those who are interested in the study of Natural History, resident in and around the metropolis, have long been accustomed to visit Epping Forest in pursuit of that study, and have often been delighted with the numerous forms of life which that wild and natural haunt has furnished to them. They are nevertheless alarmed lest the Conservators should be induced to follow the baneful example of the custodians of other localities, and resort to deep-drainage, and other so-called improvements, whereby the natural character of the Forest will be greatly injured, and certain animals and plants irretrievably exterminated. Under this feeling, they are induced to remind all those who control the destinies of the Forest that there is no apparent necessity for reducing the humidity of the soil in the interests of the ordinary visitors to the Forest; that any alteration in this direction must, of necessity, by altering the conditions under which they have long flourished, be fatal to all the flowering plants which only grow in moist situations, of which many are now natives of the Forest. Artificial disturbance of these natural conditions will not only destroy the plants themselves, but as these plants are many of them the favourite food of certain species of insects, the disappearance of the food-plants will also be accompanied by the extermination of the insects feeding upon them; such insects, in most cases, refusing to subsist on other plants. The result of such artificial disturbance would therefore be to change the character of the fauna and flora of the Forest, which it was hoped would be maintained "as nearly as possible in its natural condition." More serious consequences are apprehended from any diminution or abolition of the boggy pools, ponds and ditches, which are now numerous in the Forest. It is calculated, at a low estimate, that not less than 500 different and distinct species of microscopically minute animals and plants inhabit the stagnant waters collected in the small pools and boggy places in the Forest. In these days, when so many persons confine their biological studies almost entirely to these minute organisms, it is a subject of general regret that almost every year they are compelled to go farther and farther from London in search of the subjects of their investigations. The abolition of waste ground and the drainage of all stagnant pools, in the interests either of the builder, the cultivator of the soil, or often through lack of special knowledge on the part of the "Conservators of open spaces," have extirpated many of the most interesting organisms, which but a few years ago were abundant. Under these circumstances, it is but a small thing that the biologists of London and its vicinity ask of the Conservators of Epping Forest, but to them it is one of *vital importance* as far as the utility of the Forest is concerned. They ask that the Forest should be maintained *literally* as much as possible in its natural condition; that all drainage systems, which tend to alter completely the natural conditions of the Forest and its surroundings, may be abandoned; that no attempt be made to "improve" such places as Wanstead Flats, by reducing, limiting, or filling up the pools, and thereby "improving" some hundreds of living species of animals and plants off the face of the

Forest. And they urge emphatically that if *deep-drainage* is continued to be pursued, the entire character of the fauna and flora of the Forest must inevitably undergo a most considerable change.

II.

The Teachings of Botany as to the Management of Forests.

By Professor G. S. Boulger, F.L.S., F.G.S.

In England there has long been a most erroneous idea as to the meaning of the word Forestry. Our woodlands have been looked upon in the main as game-preserves, or as merely costly ornaments to a residential estate. The country was in early times cleared of its very general forest-growth, as indicated by the word "field," *i.e.*, "felled" clearing, except in those parts, such as the New Red Sandstone conglomerates of Sherwood and Trentham, the Eocene sands and clays of South Hampshire, and the gravels of Epping, where the geological nature of the soil rendered it worthless, at least in early times, for agricultural purposes. The growth of timber for profit in England has been mainly conducted in small artificial plantations not managed according to the natural method. This natural method consists in growing together trees of different ages, and merely substituting the annual felling of mature timber for the natural fall of aged and decayed trees. The reproduction is by seeding, or, failing that, by individual planting from a nursery. On the other hand, felling by compartments, all the trees in each compartment being of one age, and thus clearing the land periodically, is an extravagant and unnatural method, necessitating entire reliance on planting. As has been often shown, after a fire or other clearing, an entirely distinct group of trees will spring up, and when these are cleared a third kind, and so on; and continental experience has proved the growth of a forest to become in this way very irregular and uncertain as a source of revenue. Trees do not absolutely require felling, if not grown for profit, the struggle for existence and the death of aged trees securing the health of the survivors. It may be taken for granted that where trees have flourished for centuries the best policy, where no increase of income is sought for, is to leave them alone. Where, however, it is desired to plant tracts not at present under woodland, it may be necessary in some cases to prepare the land for the purpose. There is an apparent conflict of opinion on the important question of draining. Thus an experienced English forester, Mr. Lewis Bayne, writes, "Draining of young plantations is a course of preparation that cannot safely be dispensed with. Where the ground is naturally dry, light, and friable, such preliminary operation may be dispensed with; and, indeed, further loosening or draining may, in certain circumstances, be detrimental rather than favourable to the plants." Again, Brown, the author of 'The Forester,' referring especially to diseases of the larch, says, "To the want of draining may be attributed most cases of unhealthiness in plantations for forty years past;" and Mr. Grigor writes, "In Scottish moorlands more plants, perhaps, have been lost by being inserted into ground too wet than by any other cause, and it is seldom that any considerable extent of ground is found adapted for plantation without some parts requiring to be drained." On the other hand, the late Professor Bagneris, of Nancy, a great authority, wrote, "As for draining, except in cases of stagnant pools, it must be resorted to with great moderation. A few ditches judiciously dug ensure sufficient drainage, for it must not be forgotten that our most valuable species delight in very moist and even wet soils, *e. g.*, the pedunculate oak, ash, elm, hornbeam, spruce fir, and alder. This has been sometimes forgotten. Whenever the water is not

stagnant, so that the soil does not become actually marshy, draining is a mistake. There is no doubt that the premature decay of the pedunculate oak in many places, and its disappearance in others, are due to over-drainage." There is here no real discrepancy. Nursery ground should be prepared in a manner probably over-stimulating to older trees: sloping plantations, or those in deep sand or gravel, seldom or never require drainage; but a marsh on level clay or stiff loam will do so, if trees are to be grown on it for profit. Many tracts in the New Forest, the Forest of Dean, and our other ancient forests, have probably never been covered by trees, being marsh, moor, or heath-land—good cover for small game. In Epping Forest we have a tract mainly on gravel, which, however, often forms a stiffish loam. Much of the ground is sloping, forming the watershed between the Lea and the Roding, and the water is seldom absolutely stagnant even in the marshy bottoms. Hornbeam, alder, and oak will flourish in nearly every part of the Forest in its present condition; whilst deep-draining will cause their disappearance from many tracts. The Essex botanist has already to deplore the loss in this district, through drainage, of the Whortleberry and the Cranberry (*Vaccinium Vitis-idæa* and *V. oxycoccos*), and, unless the natural condition of the Forest, in its varied and unsophisticated beauties, is left unmolested, other species, perhaps of far greater importance, will be added to the list of extinctions. Further, whilst drainage and other interference must certainly thus injuriously affect our smaller flora, it is more than doubtful whether it will achieve any useful result so far as trees are concerned. The most that might be done, considering the soil, is to convert a characteristically English hard-wood forest into a bad imitation of a Scotch conifer plantation. In the case of Epping Forest, and of other open spaces round London which it is desired to retain as such for the health of the community, and not for profit, the best practical regulation would be "that no flowering plant, shrub or tree be uprooted on any pretence, or by any person, and that no timber-tree be felled unless within three yards of two other trees."

III.

On the Protection of Wild Animals and Birds.

By J. E. Harting, F.L.S., F.Z.S., Editor of the 'Zoologist.'

In carrying out a scheme such as that proposed by the Essex Field Club, namely, a scheme for the protection of indigenous wild animals within a defined area in the county of Essex, two or three points of importance should be considered. *Firstly*, an experiment of the kind, to be successful in its results, should be continued for a period of not less than three years, to give time for such species as are now scarce or extinct, but to be reintroduced, to settle down in new haunts and reproduce their kind; *secondly*, where practicable, the natural growth of trees and underwood should be as little as possible interfered with, and the making of roads be avoided, so as to ensure proper shelter and repose; and *thirdly*, attention should be confined to the protection and preservation of such species only as are already resident, or are likely to become so, within the area selected, disregarding for this purpose species of migratory habits, whose natural instinct would prompt them at certain seasons to leave the district in question.

It is perhaps too much to expect that the landowners who may be interested in the experiment, especially if they are game-preservers, should forego their accustomed privilege of shooting when and where they please; but there can be no question that the less often a gun is heard

within the protected area, the greater are the chances of success in the object in view. Every sportsman knows the effect of firing a shot at one end of a covert. It is a signal for all the pheasants, hares, and rabbits to run to the other end, from which they would undoubtedly escape were it not for the practice of placing "stops," whose business it is to keep up a gentle tapping, and so prevent the game from getting away.

But although the game-preservers need not forego their shooting, they may reasonably forbid their gamekeepers to carry guns between the first of February and the first of September, and thus ensure perfect quietude during that season of the year when most wild creatures produce their young. Many keepers doubtless will protest, and aver that they cannot keep the vermin down unless they are allowed to carry a gun; but in the first place, if they know their business properly, every sort of vermin can be taken by trapping, and in the second place it should be remembered that the protection of so-called vermin is one of the objects in view, in order to test by actual experiment whether or not their existence is compatible with the co-existence of a good head of game.

The chief foes of the game-preserver, amongst mammals, are the fox, the polecat, and the stoat. They confine their attentions chiefly to rabbits, and where these are plentiful the above-named vermin will live and thrive. But foxes may be kept in check by hounds, and the numbers of polecats and stoats may be kept within moderate limits by the judicious use of the box-trap. As a matter of fact, it is believed that the polecat has been already exterminated, or nearly so, in Essex, and hence, unless reintroduced, the idea of protecting it may be discarded. The same may be said of its relative, the marten, once an inhabitant of Epping Forest, and one of the most beautiful animals to be met with in our English woodlands. Martens are still common in some parts of Ireland, and there should be no difficulty in procuring a few pairs and turning them out in Epping Forest. The polecat and stoat, although partial to rabbits, prey on numerous other creatures less powerful than themselves; for example, the polecat takes rats, mice, frogs, and even fish, especially eels; and the stoat is particularly useful in destroying numbers of field voles and long-tailed field mice, which often do great damage by barking the trees in young plantations.

Field mice also, as well as the common house mouse found about barns and rick-yards, form the staple food of the weasel, which is, on this account, a friend rather than a foe to man. Certainly its depredations in the game preserves are insignificant, and from its diminutive size necessarily confined to such young animals as it can manage to overpower. Weasels hunt moles, and if the latter are prejudicial to the interests of the farmer (a point on which some difference of opinion prevails), the latter as their natural enemies have a further claim to man's protection.

The badger is an animal of such shy and retiring habits, that unless a considerable tract of wood were left undisturbed, the underwood uncut, and the public excluded from that particular portion of the wood, it would be useless to attempt its preservation.

For a different reason the otter would be equally difficult to return as a denizen of the protected area. Otters are great travellers, "here to-day, gone to-morrow;" but if there is a good store of fish, particularly eels, of which they are very fond, a pair, if unmolested, might be induced to make their head quarters in some sequestered part of the river.

A wood without squirrels is deprived of one of its chief ornaments, and one would be disposed to overlook the damage done to young shoots in plantations, for the sake of watching the graceful movements and wonderful agility of this otherwise inoffensive little animal. If instructions were given to keepers not to shoot squirrels, they would soon establish

themselves in any wood where sufficient food could be obtained. They live chiefly on acorns, nuts, beech-mast, growing bark, cones of larch and other pines, leafbuds and tender shoots, besides truffles and various kinds of fungi; and here it may be observed that such edible fungi as may be met with in the woods should not be inconsiderately kicked aside and destroyed, but left for food for the squirrels.

With regard to birds, the smaller species will take care of themselves if bird-catching be strictly prohibited; and there will always be plenty of summer migrants, such as blackcaps, garden warblers, nightingales, whitethroats, shrikes and flycatchers, if the underwood in the forest glades is left sufficiently in a wild, untrimmed, and natural condition to afford proper shelter and convenient nesting-places.

The birds which stand most in need of protection (if the scheme which is contemplated is to be carried out) are those woodland species which hitherto have met with the greatest persecution at the hands of game-keepers—the kestrel, tawny owl, barn owl, carrion crow, magpie, jay, and green woodpecker. All of these are most attractive in appearance, and the three first-named extremely useful in keeping down rats and mice, which not only do much damage in plantations, but consume an immense quantity of pheasants' food.

In districts where game is strictly preserved, crows and jays are undoubtedly destructive, from their partiality for eggs, which they systematically hunt for and suck. Within the area of Epping Forest, however, where game-preserving is not carried on to any great extent, this argument against their protection loses weight; and should they at any time become too numerous, their numbers may always be thinned by judicious trapping.

In conclusion it may be observed that the scheme now proposed by the Essex Field Club, to restore the district of Epping Forest as much as possible to a state of nature, can only be carried out by resolute efforts on the part of the Conservators, and by the hearty co-operation and goodwill of landowners resident in the neighbourhood. If they will use their best endeavours to prevent the felling of timber, the clearing of underwood, and the formation of made roads, and will prohibit shooting between the first of February and the first of September, they will in due course have the satisfaction of seeing around them many beautiful forest birds and wild animals which have long been strangers to the neighbourhood, and will thus contribute in no small degree to the pleasure which hundreds will derive when enjoying a summer ramble through what still remains of the ancient forest of Essex.

IV.

The Conservation of Epping Forest from the Naturalists' Standpoint.*

By Raphael Meldola, F.R.A.S., F.C.S., &c., Vice-President.

The great expanse of primitive woodland in the immediate neighbourhood of East London declared "open" to the public on May 5th, 1882, by Her Majesty the Queen, should be regarded as one of the numerous bequests to posterity marking the enlightenment of our times. The feelings leading to the agitation for the preservation of open spaces in and around the metropolis are sure indications on the part of the public

* This paper, read before the Club at the meeting on February 24th, 1883, and published in 'Nature,' vol. 27, p. 447, is reprinted here as giving a fair summary of the arguments in favour of the preservation of the natural features of Epping Forest in accordance with the Act of Parliament.—Ed.

of a recognition of the necessity for protecting and conserving our common lands for out-door recreation—a recognition which must be considered as marking a decided advancement in the ideas of the British holiday-maker. If we compare a map of the environs of London, of say twenty years ago, with the actual state of the country at the present time, it will be seen that large tracts of open land have disappeared; shady coppices and furze-clad heaths have been enclosed and built upon, and the country-loving Londoner has had to go further and further afield for his rambles. If it is obviously true that increased pressure of population demands more dwelling accommodation, it is equally true that a denser population requires more open spaces. The indifference of the public in former times to their own rights and to the wants of their successors is naturally making itself more and more seriously felt with a rapidly augmenting population, and a corresponding spread of buildings. The formation of such public bodies as the Commons Preservation Society and the Epping Forest Fund was a healthy sign that people were beginning to be alive to the gravity of the situation, and we may now fairly say that rural London is on the defensive. The remarks which I am about to offer on the present occasion are based on an unpublished article written many months ago when that wooded area in which our interest as a society centres was threatened by tramway invasion. The withdrawal of the Great Eastern Railway Company's Bill for extending their line from Chingford to High Beach in 1881, and the apparent collapse of the tramway scheme, had led to the hope that the "people's forest" would remain unmolested, and that the Epping Forest Act of 1878 would be carried out in spirit and in letter. But unfortunately new grounds of alarm have recently arisen, and our Honorary Secretaries, to whom I showed the original manuscript, did me the honour of thinking that the views which I had expressed would still be found to be in accordance with those of our own and kindred societies.

Like other open tracts in the metropolitan district, the great Waltham Forest, which comprised the Forests of Epping and Hainault, was rapidly undergoing absorption. From the Report of the Select Committee of the House of Commons presented in 1863, it appears that of the 9000 acres which constituted the Forest in 1793, only 6000 acres then remained unenclosed. In 1871, when the Corporation of London took up the Forest question, this area had been reduced to 3500 acres. I do not here propose to trouble you again with the now familiar history of the rescue of this picturesque remnant of primeval Britain.* The work commenced more than a decade ago by the Corporation of London received its crowning reward at the late Royal visitation. We shall the more appreciate the results of the action taken by the Corporation when we bear in mind that the total area dedicated to the public last May is very nearly equal to the expanse of 6000 acres reported upon by the Select Committee of 1863. But whilst expressing the gratitude of metropolitan field naturalists generally for the restoration of one of their largest and most accessible hunting-grounds, it certainly does seem to me that the shout of triumph raised by the Conservators has been allowed to drown the smaller voices of those who had previously demonstrated to certain rapacious lords of manors by somewhat forcible means that a "neighbour's landmark" was not a movable thing. It must not be forgotten that prior to the year 1871, besides many vigorous individual protests, both the Commons Preservation Society and the Epping Forest Fund had declared war against illicit enclosure. The restoration of the Forest to the people

* See Mr J. T. Bedford's 'Story of the Preservation of Epping Forest,' 'City Press' Office, 1882.

has cost a sum of money considerably exceeding a quarter of a million pounds sterling, and it will be generally admitted that this amount has been well, if not wisely, spent in the public cause. There are no doubt many who have suffered by their own cupidity, or by that of former manor lords, who still feel aggrieved at the action of the Corporation, and it must indeed be conceded that many whose estates have suffered curtailment have been the unconscious receivers of illegally acquired property, and are thus deserving of commiseration. The principles involved in the conflict between public rights on the one hand and manorial actions on the other are of the very deepest importance to the community at large, and it is therefore no matter of surprise that the "Forest Question" should have acquired a quasi-political aspect during the last few years in this neighbourhood.

As far as I have been able to learn, the motives leading to the preservation of our Forest at the great cost specified appear to have been purely philanthropic. The main object was to secure this splendid area for the "recreation and enjoyment" of Londoners generally, and more especially for the East-end inhabitants, whose chances of holiday-making are only too often limited to an occasional day in the country. In one sense the latter class may now, thanks to the movement first set in action by Mr. J. T. Bedford, claim to have a decided advantage over their wealthier West-end brethren, for the total area of the West-end parks (including Regent's) amounts only to about 1150 acres, as compared with the 5000 to 6000 acres of open country so easily accessible to East-Londoners. In the face of such an obviously enormous gain to the country rambling holiday-folk, it may perhaps seem ill-advised to attempt to criticise the action of the Conservators in their dealings with the Forest. It is with great reluctance on my part that I forsake the peaceful paths of scientific study to take up a question which generally appears to lead to nothing more than a manifestation of angry controversy, and I only do so now on behalf of that numerous and ever-increasing scientific class of holiday-makers whose claims thus far appear to have been altogether put out of court.

Long before the question of encroachment or of preservation had been brought into its present prominence, botanists, entomologists, microscopists, and students of Nature generally were in the habit of frequenting our Forest, and of rambling in quest of the objects of their study through this woodland expanse so conveniently situated with respect to the great scientific centre of this country. There are records which prove that Epping Forest has been for more than a century the hunting-ground of many who have gathered materials from its glades for the great storehouse of human knowledge, and who have taken a true and purely intellectual delight in studying its animal and vegetable productions. The London naturalists of the present time should surely have something to say in connection with the fate of the favourite haunt made classic ground to them by the memories of such men as Richard Warner, the author of the 'Plantæ Woodfordienses' (1771), Edward Forster, the Essex botanist, who wrote between the years 1784 and 1849, and Henry Doubleday, of Epping, our own grocer-naturalist, who died in 1877. It is time for the natural-history public, by no means such an insignificant body as is generally supposed, to raise their voice on behalf of these "happy hunting-grounds." The position to be taken up is not necessarily one of antagonism towards the Conservators, but it is certainly desirable that some understanding should be come to respecting the claims of those who, in pursuit of knowledge, have long been contented to bear with the pitying smile of the ignorant for "trifling away their time upon weeds, insects, and toadstools." The numerous scientific

societies and field clubs of the metropolitan districts have already declared their views on former occasions, and it is chiefly with the object of attempting to define the respective attitudes of the parties concerned that I have entered the arena on this occasion.

There are at the present time more than twenty Natural History Clubs in the environs of London, and of these many have long been in the habit of making collecting excursions to our Forest. Our own Society and our Walthamstow colleagues have their head-quarters in the Forest district. Some of the East-end clubs are entirely composed of working men, and have done excellent work in fostering a healthy taste for the study of out-door natural history among this class of the community, a matter of considerable importance to us when we so often hear that the Forest has been acquired as a recreation-ground chiefly for the working men of East London. In addition to these numerous local clubs there are the great London societies, which, like the Linnean, Zoological, Entomological, Royal Microscopical, and Quekett Club, are all interested in promoting the study of biology in its various branches. Now, in face of the rapid destruction of all the truly wild tracts of country in the vicinity of London, it must assuredly be of the greatest importance to the natural-history public as a body to watch with the most jealous eye the dealings of those in authority with this the largest, wildest, and most accessible of all the open spaces in the metropolitan district. To naturalists generally such a tract of primitive country as that which has come under the management of the Corporation is something more than a mere picnicking-ground; to all students of Nature it is a *biological preserve*. Nay, I will even go so far as to declare that forest management is essentially a scientific subject in itself—a natural-history question in the broadest sense. Now, with the exception of our esteemed members the Verderers, by whom we were invited to a conference some months ago, it appears to me that the Conservators as a body, and a confessedly unscientific body, are not aware that scientific counsel is necessary to enable them to faithfully carry out the Act of Parliament, *i. e.*, to keep the area committed to their charge in its "*natural aspect*" *as a forest*. I will therefore take the present opportunity of pointing out that scientific criticism would have been disarmed and the fears of natural-history students allayed if the Epping Forest Committee had only recognised the claims of Science by consulting, let us say, the Directorate of Kew Gardens, or by appealing to the councils of some of the London Scientific Societies.

If we consider the actual work done during the period that the Forest has been under the jurisdiction of the Corporation, we may fairly say that the energies of this body have hitherto been developed in the direction of landscape gardening; *i. e.*, of *artificialising* certain portions of the Forest. The great hotel at Chingford has been made the centre of convergence of a number of roads, some of which have been newly cut, even at the risk of being superfluous. The aquatically-disposed holiday-maker may hire boats in which he can paddle about on "ornamental water," or can embark on a floating machine turned by hand-paddles, and possibly constructed with a view to delude the occupants into the belief that they are on board a steamer. The exhausted East Londoner, whose vitality appears to require that recuperation which seems to be derivable from swinging, steam-roundabouts, and throwing sticks at cocoa-nuts, has been amply provided for, and his wants have in every way been attended to. In 1881 the Forest was threatened by a railway, in 1882 by a tramway, and again this year another railway bill is about to be introduced into Parliament. To all these schemes the Committee, no doubt with the best motives, gave and still give their support, and one has to seriously ask what is the meaning of the word "Conservator," and how far this

attitude is compatible with the instruction that "the Conservators shall at all times as far as possible preserve the natural aspect of the Forest," and "shall by all lawful means prevent, resist, and abate all future enclosures, encroachments, and buildings, and all attempts to enclose, encroach, or build on any part thereof, or to appropriate or use the same, or the soil, timber, or roads thereof, or any part thereof, or for any purpose inconsistent with the objects of" the Act of 1878. It must not be supposed that there is any desire on the part of naturalists to exclude the general public. I wish only to emphasise the fact that up to the present time it would appear that the Forest has fallen into the hands of those who are disposed to regard it exclusively from the point of view of excursionists and "cheap trips," and in accordance with the principle that supply and demand act and re-act it may be expected that this class—which has thus far alone been catered for—will more and more frequent the Forest district. Increased accommodation for excursionists means, if we may judge from the line of action pursued by the Conservators, an extension of facilities for swinging and donkey-riding. The "improvements" that have hitherto been made have not been of such a nature as to preserve the woodland in its native beauty, but have been limited to the conversion of a portion of the Forest land into a resort for pleasure-seekers of the class indicated. To the naturalist—and, I am sure, I may say to the intelligent public generally—such a tract of primitive country is beautiful only so long as Nature is given full sway, and the adjustments which for long ages have been going on slowly and silently under the operation of natural laws remain unchecked and uninterfered with by man. No unscientific body of Conservators can possibly realise to the fullest extent the seriousness of the charge committed to their care.

With respect to the management of the Forest, the views of naturalists are now so well known that no excuse can be made for ignoring them. Our wants are of the simplest and most economical nature—our case is perfectly met by the trite aphorism, "let well alone." The whole forest area at present existing may be considered to consist of primitive woodland and of tracts formerly under cultivation. The former can best be dealt with by leaving the "management" to Nature; whilst the latter should be naturalised as soon as possible. And here we cannot close our eyes to the fact that while a large amount of money has been expended in altering portions of the Forest proper, no attempt has yet been made to plant or to restore to a natural condition those unsightly tracts which were formerly enclosed, and of which many remain as barren wastes to the present time. The cause of the naturalist is thus imperilled, both by the active and by the passive position of the Committee; he is like the pitcher in the Italian proverb, which says that "whether the pitcher hits the stone or the stone hits the pitcher, it is always the worse for the pitcher."

It is now quite unnecessary to make detailed statements of the views of individual naturalists with reference to the present subject. It will be remembered that at a meeting of this Society held last year, Sir Thomas Fowell Buxton brought forward a proposal—and a very excellent one it was—that all land-owners round the Forest district should agree to stop generally the destruction of all birds and animals on their estates, so that a great experiment might be carried out for some years, leading to a true "balance of nature" in the whole area comprised between the valleys of the Lea and Roding. At the discussion arising from that suggestion, the preservation of the fauna and flora as a whole was advocated, and many naturalists, whose opinions will carry great weight, expressed their views on the question of forest management. The complete report of this meeting appears herewith, with appended papers by Dr. Cooke, Mr. J. E.

Harting and Prof. Boulger. The evils of deep drainage, from the naturalists' point of view, which form the text of Dr. Cooke's protest, have already been pointed out by many, and I will just call your attention to some remarks on this subject by our eminent honorary member, Mr. A. R. Wallace, in an able article published in the 'Fortnightly Review' for November, 1878, wherein he says:—"It must be remembered, too, that a proportion of bog and swamp and damp hollows are essential parts of the 'natural aspect' of every great forest tract. It is in and around such places many trees and shrubs grow most luxuriantly; it is such spots that will be haunted by interesting birds and rare insects; and there alone many of the gems of our native flora may still be found. Every naturalist searches for such spots as his best hunting-grounds. Every lover of Nature finds them interesting and enjoyable." After enumerating some of the rarer marsh plants of our Forest, Mr. Wallace continues:—"These and many other choice plants would be exterminated if by too severe drainage all such wet places were made dry; the marsh birds and rare insects which haunted them would disappear, and thus a chief source of recreation and enjoyment to that numerous and yearly-increasing class who delight in wild flowers, birds, and insects, would be seriously interfered with."

It is somewhat exceptional for a society founded for the study and promotion of natural science to find itself engaged in active polemics, but in taking up the position into which we have been forced we are simply carrying out that line of action which at our foundation I ventured to lay down as our true function with respect to the Forest.* It is extremely unfortunate that the claims of Science should appear to be opposed to the wants of the general public—I say should *appear* to be opposed, because I am convinced that there is no real antagonism. The grievance of naturalists is not only that their claims have been ignored, but the action of the Conservators has hitherto been entirely on the destructive side, and a feeling of alarm has arisen lest the whole of the Forest should piecemeal be desecrated in the name of a fictitious philanthropy. The public wants—as interpreted by the Board of Conservators—are made to take the form of clearing of underwood, deep drainage, road-making, the intersection of the Forest by railways and tramways, and ample public-house accommodation. If these are really the fundamental requirements of holiday-seekers, then there must for ever be a strong antagonism between this class of the public and those whose cause I have taken it upon myself to advocate. At this juncture, however, we may fairly ask whether this kind of artificialised recreation-ground, *à la* Cremorne, is actually demanded by the frequenters of the Forest. I believe myself that it is not. The notion of keeping a holiday in what is only too often a bestial manner is not a fair estimate of the British excursionist. If he gives way to the temptations which have been so lavishly scattered in his path it is, as Shakespeare puts into the mouth of King John, because "the sight of means to do ill deeds make ill deeds done." The East Londoner who wishes to spend a day in a people's park is provided for elsewhere, but if we consent to the denaturalising of our Forest, the more intelligent class of excursionists—and their name is legion—will be either driven from its precincts or will suffer that degeneration which the line of action at present pursued is exclusively calculated to bring about.

In the course of these remarks I may have somewhat exaggerated the supposed antagonism between the two classes most interested in the conservation of Epping Forest, but I have done so with the object of defining as sharply as possible the position of the hitherto unconsidered naturalist.

* See "Inaugural Address," 'Transactions,' Vol. i., pp. 19, 20.

The conditions requisite for transforming the Forest into a "people's park" are fatal to its preservation as a natural-history resort. Any piece of waste land can be made into a park, but a tract of wild forest once destroyed can never be restored. I would once more urge, and most emphatically, that there is not the slightest desire on the part of naturalists to exclude the "toiling million," or to prevent their full enjoyment of the Forest. I wish only to point out that my present contention is that in the long run the wants, both of the naturalist and of the ordinary excursionist, will be found to be absolutely coincident. If the neighbourhood of a railway terminus, with its concomitant evils, leads to the destruction of the "natural aspect" of any portion of the Forest, that portion is ruined not only for the naturalist, but likewise for the general public who come to enjoy a day in the country far from "the busy hum of men." By judicious management the requirements of both classes can be met, and it rests entirely with the Conservators to determine whether the attitude of the respective parties is to be pacific or the reverse. It must be remembered that long before the Forest was rescued by the Corporation this district was a favourite resort of multitudes of holiday-folk, and, not being interfered with to any considerable extent, was at the same time available to the naturalist. The note of alarm must be sounded, or we may find ourselves worse off than in pre-Conservatorial times. The constitution of the Epping Forest Committee is apparently prejudicial to our interests, if we may judge by the standard of past and present actions. Of this Committee the Verderers, who, as representing the Commoners, and as residents in the Forest district, are best qualified to advise with respect to the management of the Forest, form but four of a Committee of sixteen. However enlightened the views of these gentlemen may be—and I only wish I could say that the present Verderers were unanimously of our way of thinking—they are thus liable to be out-voted. Another evil, and a most serious one so far as we are concerned, is that the Committee is practically a secret one—its proceedings are conducted with closed doors, and the people at large, whether naturalists or excursionists, have no means of making their voices heard. Whether this action is just in a case where the funds are derived from a public source it does not enter into my province to consider.

The views which I have now put forward are offered with the best of intentions with respect to the body Conservatorial. We cannot be unmindful of our obligation to the Corporation for having saved the Forest, but we appeal to them to assist in exalting the ideas of those who frequent this place as a holiday resort instead of pandering solely to the more degraded aspect of human nature. A day spent amid the natural beauties of our sylvan glades is the beau-ideal of a holiday, intellectually, morally, and physically, to those whose pursuits keep them confined to the town. Let Epping Forest be preserved for the multitudes who have for so long enjoyed it rationally. The "recreation and enjoyment of the public" will thus become possessed of a higher meaning, and the naturalist, whilst carrying on his studies as heretofore, will be doubly grateful to those who have secured these time-honoured preserves as a public space free from all fear of enclosure and destruction. The ideas which I have attempted to formulate are, I know, entertained by large numbers not only of working naturalists, but also of the continually growing class of lovers of the country and of Nature in general. It is becoming a matter of almost national importance that the surviving tracts of open country in the neighbourhood of all large towns should be rigidly preserved, and opinions in accordance with this have from time to time been forcibly expressed both with respect to our own Forest and all the common lands in the environs of London.

V.

The Essex Field Club's Statement *in re* "The Great Eastern Railway Bill, High Beach Extension (1883)." *

Drawn up by the Honorary Secretary.

The Council and Members of the Essex Field Club wish most respectfully to place before Members of Parliament, students and lovers of Nature, and the public generally, the following objections to the scheme for running a line of railway from Chingford to High Beach across Epping Forest:—

1. Although the scheme (and former ones of a like nature) is (and have been) fomented and aided in every possible way, for inscrutable reasons, by the great influence of the Corporation of London, acting as "Conservators" of Epping Forest, and also by individual members of the Epping Forest Committee, we submit that such tampering with the Forest, and promotion of private companies' schemes of speculation, is in direct contravention of the letter and spirit of the Epping Forest Act, 1878. The Act directs [Section 7 (1)] that:—

"The Conservators shall at all times keep Epping Forest *unenclosed and unbuilt on*, as an open space for the recreation of the public; and they *shall by all lawful means prevent, resist and abate all future enclosures, encroachments*, and *buildings*, and all *attempts to enclose, encroach, or build on any part thereof*, or to appropriate or use the same, or the soil, timber or roads thereof, or any part thereof, for any purpose inconsistent with the objects of this Act." And (2) "The Conservators shall not *sell, demise*, or otherwise *alienate* any part of the Forest, or *concur* in any *sale, demise*, or other *alienation* thereof, or any part thereof." And (3) "The Conservators shall at all times, as far as possible, PRESERVE THE NATURAL ASPECT of the FOREST."

We are informed that, in the face of these express stipulations, the Corporation Seal has been affixed to an agreement by which the Forest land required for the line is to be conveyed to the Railway Company, the only consideration being the formation of roads and ways, which would be in themselves a furthur encroachment upon the Forest.

2. We most emphatically assert that the proposed line is *wholly unnecessary*, inasmuch as there is at present ample accommodation for public access to the Forest. There are *two lines of railway* skirting the woodlands on the eastern and western sides, with FOREST STATIONS at (1) WOOD STREET (within three furlongs of lovely forest glades); (2) at HALE END (half-mile from excellent woodland district, "Oak Hill" and "Rushy Plain"); (3) CHINGFORD (*on* the Forest, within a very short distance of masses of natural "bush" and woodland, including 1650 acres within two miles radius; touching parts of the Forest "beautified" and "improved" by the Conservators, and crowned by the "Royal Forest Hotel"); † (4)

* This document was issued by the Council on February 27th, 1883, and sent by post to all the members of the House of Commons, to the principal London newspapers, and to various gentlemen known to be interested in open spaces. It is believed that the facts therein brought forward placed the matter in its true light, and contributed in some degree to the rejection of the Bill by Parliament. As the "Statement" is referred to in the opening pages of this pamphlet, it is given here *in extenso*, as a justification of the action of the Club in opposing the projected railway invasion, and as a collection of data which will probably be useful in the future in any efforts to withstand other schemes of Vandalism so likely to be put forward, it is rumoured, while the management of the Forest remains in its present unsatisfactory condition.—ED.

† Those who wish well to the cause of open spaces and rational holiday-making should study the results of the four years' Conservatorial management and taste exhibited at Chingford. The "forestal" operations will be noted: such attempts at tree-planting

Forest Gate (half-mile from Wanstead Flats); (5) Leytonstone (the Avenues, Bush-wood, and Whipps Cross); (6) Snaresbrook (*on* the Forest, Wanstead Heathland, Snaresbrook pond, "Gilbert Slade," and Wanstead Park); (7) George Lane (within one mile of open wild forest); (8) Woodford (ditto); (9) Buckhurst Hill (for Lord's Bushes, Roding Valley, and very large extent of common and woodland in primitive condition); (10) Loughton (half-mile from Forest, *one mile from High Beach*, and affording within a radius of two miles upwards of 2000 acres of the finest woodland scenery); (11) Chigwell Lane (with country lanes and meadow paths, leading, within a radius of two miles, to at least 800 acres of ancient woodland); (12) Theydon Bois (*on* the Forest, and rendering accessible within a radius of two miles 1050 acres of the very best and most retired woodland, in which the deer most do congregate); (13) Epping (for Epping Plain and woodland, with charming field paths and open country). In addition to these, most pleasant walks to the Forest may be taken from St. James' Street, on the Walthamstow line; from Tottenham, Water Lane, and Waltham Abbey on the Great Eastern main line; and tramways and omnibuses run to the verge of the Forest at Leytonstone and Whipps Cross, and to Woodford. Conveyances can be had at a cheap rate at all the Forest stations, and Epping Forest has for many years been a favourite place for excursions by means of the well-known "school van."

3. We affirm that the fundamental idea of the long-continued efforts in favour of preserving Epping Forest was, and the leading principle of the Epping Forest Act is, that the district should be preserved as a natural Forest, distinct in character and mode of management from an ordinary park or pleasure ground. The supposed wants and pleasures of the ordinary unintelligent excursionist, who we are assured cannot walk a few hundred yards from his point of arrival to enjoy the best sylvan scenery, have been amply met by the Conservatorial and publican's arrangements at Chingford and elsewhere. It is not just that *all* parts of the Forest should be equally vulgarised and denaturalised, and that the wishes of the great mass of intelligent Londoners, of all classes, who look to enjoy Epping Forest in a rational and healthy way, should be *utterly* disregarded. The scenes recently enacted at Chingford, the vice and rowdyism permitted and *attracted* there, have closed that once delightful spot to the lovers of rural quiet and freshness. At present High Beach (readily accessible from Loughton Station) is the rendezvous of the better class of visitors. It is an open secret that if the proposed line is made, a large public-house is likely to be erected at High Beach, and the Chingford policy repeated. Mr. Glass, a gentleman of twenty years' experience as a London Sunday-school manager and teacher, assured Sir John Lubbock at the recent deputation that the teachers had decided to take their "school-treats" to High Beach in future (by "vans"), so as to escape the contamination of the rougher elements attracted to Chingford, and that if similar social deterioration overtook High Beach they would be practically shut out of the Forest altogether. And the school-children are the very class for which the advocates of the railway profess to be working!

4. The projected railway would not only be a serious encroachment upon the Forest, by abstracting for private purposes land dedicated to the public, but would sever it into two portions, and shut off nearly four hundred acres of delightful woodland. The line must be carried over

are really touching in their sweet simplicity. During the summer, fireworks, *steam* "roundabouts," and *shooting at wine-bottles suspended from forest trees* are amusements officially recognised and encouraged.

within the protected area, the greater are the chances of success in the object in view. Every sportsman knows the effect of firing a shot at one end of a covert. It is a signal for all the pheasants, hares, and rabbits to run to the other end, from which they would undoubtedly escape were it not for the practice of placing "stops," whose business it is to keep up a gentle tapping, and so prevent the game from getting away.

But although the game-preservers need not forego their shooting, they may reasonably forbid their gamekeepers to carry guns between the first of February and the first of September, and thus ensure perfect quietude during that season of the year when most wild creatures produce their young. Many keepers doubtless will protest, and aver that they cannot keep the vermin down unless they are allowed to carry a gun; but in the first place, if they know their business properly, every sort of vermin can be taken by trapping, and in the second place it should be remembered that the protection of so-called vermin is one of the objects in view, in order to test by actual experiment whether or not their existence is compatible with the co-existence of a good head of game.

The chief foes of the game-preserver, amongst mammals, are the fox, the polecat, and the stoat. They confine their attentions chiefly to rabbits, and where these are plentiful the above-named vermin will live and thrive. But foxes may be kept in check by hounds, and the numbers of polecats and stoats may be kept within moderate limits by the judicious use of the box-trap. As a matter of fact, it is believed that the polecat has been already exterminated, or nearly so, in Essex, and hence, unless reintroduced, the idea of protecting it may be discarded. The same may be said of its relative, the marten, once an inhabitant of Epping Forest, and one of the most beautiful animals to be met with in our English woodlands. Martens are still common in some parts of Ireland, and there should be no difficulty in procuring a few pairs and turning them out in Epping Forest. The polecat and stoat, although partial to rabbits, prey on numerous other creatures less powerful than themselves; for example, the polecat takes rats, mice, frogs, and even fish, especially eels; and the stoat is particularly useful in destroying numbers of field voles and long-tailed field mice, which often do great damage by barking the trees in young plantations.

Field mice also, as well as the common house mouse found about barns and rick-yards, form the staple food of the weasel, which is, on this account, a friend rather than a foe to man. Certainly its depredations in the game preserves are insignificant, and from its diminutive size necessarily confined to such young animals as it can manage to overpower. Weasels hunt moles, and if the latter are prejudicial to the interests of the farmer (a point on which some difference of opinion prevails), the latter as their natural enemies have a further claim to man's protection.

The badger is an animal of such shy and retiring habits, that unless a considerable tract of wood were left undisturbed, the underwood uncut, and the public excluded from that particular portion of the wood, it would be useless to attempt its preservation.

For a different reason the otter would be equally difficult to return as a denizen of the protected area. Otters are great travellers, "here to-day, gone to-morrow;" but if there is a good store of fish, particularly eels, of which they are very fond, a pair, if unmolested, might be induced to make their head quarters in some sequestered part of the river.

A wood without squirrels is deprived of one of its chief ornaments, and one would be disposed to overlook the damage done to young shoots in plantations, for the sake of watching the graceful movements and wonderful agility of this otherwise inoffensive little animal. If instructions were given to keepers not to shoot squirrels, they would soon establish

themselves in any wood where sufficient food could be obtained. They live chiefly on acorns, nuts, beech-mast, growing bark, cones of larch and other pines, leafbuds and tender shoots, besides truffles and various kinds of fungi; and here it may be observed that such edible fungi as may be met with in the woods should not be inconsiderately kicked aside and destroyed, but left for food for the squirrels.

With regard to birds, the smaller species will take care of themselves if bird-catching be strictly prohibited; and there will always be plenty of summer migrants, such as blackcaps, garden warblers, nightingales, whitethroats, shrikes and flycatchers, if the underwood in the forest glades is left sufficiently in a wild, untrimmed, and natural condition to afford proper shelter and convenient nesting-places.

The birds which stand most in need of protection (if the scheme which is contemplated is to be carried out) are those woodland species which hitherto have met with the greatest persecution at the hands of game-keepers—the kestrel, tawny owl, barn owl, carrion crow, magpie, jay, and green woodpecker. All of these are most attractive in appearance, and the three first-named extremely useful in keeping down rats and mice, which not only do much damage in plantations, but consume an immense quantity of pheasants' food.

In districts where game is strictly preserved, crows and jays are undoubtedly destructive, from their partiality for eggs, which they systematically hunt for and suck. Within the area of Epping Forest, however, where game-preserving is not carried on to any great extent, this argument against their protection loses weight; and should they at any time become too numerous, their numbers may always be thinned by judicious trapping.

In conclusion it may be observed that the scheme now proposed by the Essex Field Club, to restore the district of Epping Forest as much as possible to a state of nature, can only be carried out by resolute efforts on the part of the Conservators, and by the hearty co-operation and goodwill of landowners resident in the neighbourhood. If they will use their best endeavours to prevent the felling of timber, the clearing of underwood, and the formation of made roads, and will prohibit shooting between the first of February and the first of September, they will in due course have the satisfaction of seeing around them many beautiful forest birds and wild animals which have long been strangers to the neighbourhood, and will thus contribute in no small degree to the pleasure which hundreds will derive when enjoying a summer ramble through what still remains of the ancient forest of Essex.

IV.

The Conservation of Epping Forest from the Naturalists' Standpoint.*

By Raphael Meldola, F.R.A.S., F.C.S., &c., Vice-President.

The great expanse of primitive woodland in the immediate neighbourhood of East London declared "open" to the public on May 5th, 1882, by Her Majesty the Queen, should be regarded as one of the numerous bequests to posterity marking the enlightenment of our times. The feelings leading to the agitation for the preservation of open spaces in and around the metropolis are sure indications on the part of the public

* This paper, read before the Club at the meeting on February 24th, 1883, and published in 'Nature,' vol. 27, p. 447, is reprinted here as giving a fair summary of the arguments in favour of the preservation of the natural features of Epping Forest in accordance with the Act of Parliament.—Ed.

of a recognition of the necessity for protecting and conserving our common lands for out-door recreation—a recognition which must be considered as marking a decided advancement in the ideas of the British holiday-maker. If we compare a map of the environs of London, of say twenty years ago, with the actual state of the country at the present time, it will be seen that large tracts of open land have disappeared; shady coppices and furze-clad heaths have been enclosed and built upon, and the country-loving Londoner has had to go further and further afield for his rambles. If it is obviously true that increased pressure of population demands more dwelling accommodation, it is equally true that a denser population requires more open spaces. The indifference of the public in former times to their own rights and to the wants of their successors is naturally making itself more and more seriously felt with a rapidly augmenting population, and a corresponding spread of buildings. The formation of such public bodies as the Commons Preservation Society and the Epping Forest Fund was a healthy sign that people were beginning to be alive to the gravity of the situation, and we may now fairly say that rural London is on the defensive. The remarks which I am about to offer on the present occasion are based on an unpublished article written many months ago when that wooded area in which our interest as a society centres was threatened by tramway invasion. The withdrawal of the Great Eastern Railway Company's Bill for extending their line from Chingford to High Beach in 1881, and the apparent collapse of the tramway scheme, had led to the hope that the "people's forest" would remain unmolested, and that the Epping Forest Act of 1878 would be carried out in spirit and in letter. But unfortunately new grounds of alarm have recently arisen, and our Honorary Secretaries, to whom I showed the original manuscript, did me the honour of thinking that the views which I had expressed would still be found to be in accordance with those of our own and kindred societies.

Like other open tracts in the metropolitan district, the great Waltham Forest, which comprised the Forests of Epping and Hainault, was rapidly undergoing absorption. From the Report of the Select Committee of the House of Commons presented in 1863, it appears that of the 9000 acres which constituted the Forest in 1793, only 6000 acres then remained unenclosed. In 1871, when the Corporation of London took up the Forest question, this area had been reduced to 3500 acres. I do not here propose to trouble you again with the now familiar history of the rescue of this picturesque remnant of primeval Britain.* The work commenced more than a decade ago by the Corporation of London received its crowning reward at the late Royal visitation. We shall the more appreciate the results of the action taken by the Corporation when we bear in mind that the total area dedicated to the public last May is very nearly equal to the expanse of 6000 acres reported upon by the Select Committee of 1863. But whilst expressing the gratitude of metropolitan field naturalists generally for the restoration of one of their largest and most accessible hunting-grounds, it certainly does seem to me that the shout of triumph raised by the Conservators has been allowed to drown the smaller voices of those who had previously demonstrated to certain rapacious lords of manors by somewhat forcible means that a "neighbour's landmark" was not a movable thing. It must not be forgotten that prior to the year 1871, besides many vigorous individual protests, both the Commons Preservation Society and the Epping Forest Fund had declared war against illicit enclosure. The restoration of the Forest to the people

* See Mr J. T. Bedford's 'Story of the Preservation of Epping Forest,' 'City Press' Office, 1832.

has cost a sum of money considerably exceeding a quarter of a million pounds sterling, and it will be generally admitted that this amount has been well, if not wisely, spent in the public cause. There are no doubt many who have suffered by their own cupidity, or by that of former manor lords, who still feel aggrieved at the action of the Corporation, and it must indeed be conceded that many whose estates have suffered curtailment have been the unconscious receivers of illegally acquired property, and are thus deserving of commiseration. The principles involved in the conflict between public rights on the one hand and manorial actions on the other are of the very deepest importance to the community at large, and it is therefore no matter of surprise that the "Forest Question" should have acquired a quasi-political aspect during the last few years in this neighbourhood.

As far as I have been able to learn, the motives leading to the preservation of our Forest at the great cost specified appear to have been purely philanthropic. The main object was to secure this splendid area for the "recreation and enjoyment" of Londoners generally, and more especially for the East-end inhabitants, whose chances of holiday-making are only too often limited to an occasional day in the country. In one sense the latter class may now, thanks to the movement first set in action by Mr. J. T. Bedford, claim to have a decided advantage over their wealthier West-end brethren, for the total area of the West-end parks (including Regent's) amounts only to about 1150 acres, as compared with the 5000 to 6000 acres of open country so easily accessible to East-Londoners. In the face of such an obviously enormous gain to the country rambling holiday-folk, it may perhaps seem ill-advised to attempt to criticise the action of the Conservators in their dealings with the Forest. It is with great reluctance on my part that I forsake the peaceful paths of scientific study to take up a question which generally appears to lead to nothing more than a manifestation of angry controversy, and I only do so now on behalf of that numerous and ever-increasing scientific class of holiday-makers whose claims thus far appear to have been altogether put out of court.

Long before the question of encroachment or of preservation had been brought into its present prominence, botanists, entomologists, microscopists, and students of Nature generally were in the habit of frequenting our Forest, and of rambling in quest of the objects of their study through this woodland expanse so conveniently situated with respect to the great scientific centre of this country. There are records which prove that Epping Forest has been for more than a century the hunting-ground of many who have gathered materials from its glades for the great storehouse of human knowledge, and who have taken a true and purely intellectual delight in studying its animal and vegetable productions. The London naturalists of the present time should surely have something to say in connection with the fate of the favourite haunt made classic ground to them by the memories of such men as Richard Warner, the author of the 'Plantæ Woodfordienses' (1771), Edward Forster, the Essex botanist, who wrote between the years 1784 and 1849, and Henry Doubleday, of Epping, our own grocer-naturalist, who died in 1877. It is time for the natural-history public, by no means such an insignificant body as is generally supposed, to raise their voice on behalf of these "happy hunting-grounds." The position to be taken up is not necessarily one of antagonism towards the Conservators, but it is certainly desirable that some understanding should be come to respecting the claims of those who, in pursuit of knowledge, have long been contented to bear with the pitying smile of the ignorant for "trifling away their time upon weeds, insects, and toadstools." The numerous scientific

societies and field clubs of the metropolitan districts have already declared their views on former occasions, and it is chiefly with the object of attempting to define the respective attitudes of the parties concerned that I have entered the arena on this occasion.

There are at the present time more than twenty Natural History Clubs in the environs of London, and of these many have long been in the habit of making collecting excursions to our Forest. Our own Society and our Walthamstow colleagues have their head-quarters in the Forest district. Some of the East-end clubs are entirely composed of working men, and have done excellent work in fostering a healthy taste for the study of out-door natural history among this class of the community, a matter of considerable importance to us when we so often hear that the Forest has been acquired as a recreation-ground chiefly for the working men of East London. In addition to these numerous local clubs there are the great London societies, which, like the Linnean, Zoological, Entomological, Royal Microscopical, and Quekett Club, are all interested in promoting the study of biology in its various branches. Now, in face of the rapid destruction of all the truly wild tracts of country in the vicinity of London, it must assuredly be of the greatest importance to the natural-history public as a body to watch with the most jealous eye the dealings of those in authority with this the largest, wildest, and most accessible of all the open spaces in the metropolitan district. To naturalists generally such a tract of primitive country as that which has come under the management of the Corporation is something more than a mere picnicking-ground; to all students of Nature it is a *biological preserve*. Nay, I will even go so far as to declare that forest management is essentially a scientific subject in itself—a natural-history question in the broadest sense. Now, with the exception of our esteemed members the Verderers, by whom we were invited to a conference some months ago, it appears to me that the Conservators as a body, and a confessedly unscientific body, are not aware that scientific counsel is necessary to enable them to faithfully carry out the Act of Parliament, *i. e.*, to keep the area committed to their charge in its "*natural aspect*" *as a forest*. I will therefore take the present opportunity of pointing out that scientific criticism would have been disarmed and the fears of natural-history students allayed if the Epping Forest Committee had only recognised the claims of Science by consulting, let us say, the Directorate of Kew Gardens, or by appealing to the councils of some of the London Scientific Societies.

If we consider the actual work done during the period that the Forest has been under the jurisdiction of the Corporation, we may fairly say that the energies of this body have hitherto been developed in the direction of landscape gardening; *i. e.*, of *artificialising* certain portions of the Forest. The great hotel at Chingford has been made the centre of convergence of a number of roads, some of which have been newly cut, even at the risk of being superfluous. The aquatically-disposed holiday-maker may hire boats in which he can paddle about on "ornamental water," or can embark on a floating machine turned by hand-paddles, and possibly constructed with a view to delude the occupants into the belief that they are on board a steamer. The exhausted East Londoner, whose vitality appears to require that recuperation which seems to be derivable from swinging, steam-roundabouts, and throwing sticks at cocoa-nuts, has been amply provided for, and his wants have in every way been attended to. In 1881 the Forest was threatened by a railway, in 1882 by a tramway, and again this year another railway bill is about to be introduced into Parliament. To all these schemes the Committee, no doubt with the best motives, gave and still give their support, and one has to seriously ask what is the meaning of the word "Conservator," and how far this

attitude is compatible with the instruction that "the Conservators shall at all times as far as possible preserve the natural aspect of the Forest," and "shall by all lawful means prevent, resist, and abate all future enclosures, encroachments, and buildings, and all attempts to enclose, encroach, or build on any part thereof, or to appropriate or use the same, or the soil, timber, or roads thereof, or any part thereof, or for any purpose inconsistent with the objects of" the Act of 1878. It must not be supposed that there is any desire on the part of naturalists to exclude the general public. I wish only to emphasise the fact that up to the present time it would appear that the Forest has fallen into the hands of those who are disposed to regard it exclusively from the point of view of excursionists and "cheap trips," and in accordance with the principle that supply and demand act and re-act it may be expected that this class—which has thus far alone been catered for—will more and more frequent the Forest district. Increased accommodation for excursionists means, if we may judge from the line of action pursued by the Conservators, an extension of facilities for swinging and donkey-riding. The "improvements" that have hitherto been made have not been of such a nature as to preserve the woodland in its native beauty, but have been limited to the conversion of a portion of the Forest land into a resort for pleasure-seekers of the class indicated. To the naturalist—and, I am sure, I may say to the intelligent public generally—such a tract of primitive country is beautiful only so long as Nature is given full sway, and the adjustments which for long ages have been going on slowly and silently under the operation of natural laws remain unchecked and uninterfered with by man. No unscientific body of Conservators can possibly realise to the fullest extent the seriousness of the charge committed to their care.

With respect to the management of the Forest, the views of naturalists are now so well known that no excuse can be made for ignoring them. Our wants are of the simplest and most economical nature—our case is perfectly met by the trite aphorism, "let well alone." The whole forest area at present existing may be considered to consist of primitive woodland and of tracts formerly under cultivation. The former can best be dealt with by leaving the "management" to Nature; whilst the latter should be naturalised as soon as possible. And here we cannot close our eyes to the fact that while a large amount of money has been expended in altering portions of the Forest proper, no attempt has yet been made to plant or to restore to a natural condition those unsightly tracts which were formerly enclosed, and of which many remain as barren wastes to the present time. The cause of the naturalist is thus imperilled, both by the active and by the passive position of the Committee; he is like the pitcher in the Italian proverb, which says that "whether the pitcher hits the stone or the stone hits the pitcher, it is always the worse for the pitcher."

It is now quite unnecessary to make detailed statements of the views of individual naturalists with reference to the present subject. It will be remembered that at a meeting of this Society held last year, Sir Thomas Fowell Buxton brought forward a proposal—and a very excellent one it was—that all land-owners round the Forest district should agree to stop generally the destruction of all birds and animals on their estates, so that a great experiment might be carried out for some years, leading to a true "balance of nature" in the whole area comprised between the valleys of the Lea and Roding. At the discussion arising from that suggestion, the preservation of the fauna and flora as a whole was advocated, and many naturalists, whose opinions will carry great weight, expressed their views on the question of forest management. The complete report of this meeting appears herewith, with appended papers by Dr. Cooke, Mr. J. E.

manner. Though in the reservation of common lands these parochial rights are apparently inevitable, they are certainly adverse to the best interest of the forests, and therefore of the public, and should only be exercised under the authority and supervision of the Forest officers. Some of the disused gravel-pits, when really exhausted and not merely abandoned by the whims of destructive diggers, might well be made into natural, irregular, and picturesque pieces of water, instead of being elaborately drained as at present.

We next drove to the "plain" by Chingford Station, an extensive grass fallow marked by ridge and furrow and almost treeless. Though it may be desirable to leave much of this open, especially when rendered more level by rolling, as a drill-field and gallop, yet it would be well to take advantage of the shelter afforded by Hawkwood on the crest of the hill to break the stiff boundary of that wood by planting.

Between Hawkwood and Bury Wood there is a patch of fallow separated from Chingford Plain by a belt of trees, and thus admirably adapted for the site of a nursery, for which purpose it might be enclosed without serious detriment to any one. In Hawkwood itself is an illustration of pollard Hornbeams unthinned, overcrowded, killing one another, rotting at their tops, and sending up vertical, unpicturesque, and leafless branches. Probably half of these, if not more, might be removed with advantage to the remainder; but much judgment should be exercised in selection, and there are other forestal operations which more pressingly demand the attention of the Conservators. There is only a scanty undergrowth of Hawthorn; but it must be remembered that in many of our most beautiful tree-glades, such as High Beach and Little Monk Wood here, and in Fir woods generally, we cannot have underwood.

In traversing Bury Wood, near Hawkwood Farm, we came upon an open green glade or "ride" that well illustrated what such gangways should be, as contrasted with those that have been made during the last five years. Its sides were not straight or even, nor was the central space unbroken. There were clumps of Blackthorn, Bramble, and Briar, with here and there a fine young tree springing from the centre of one of these natural *chevaux-de-frise*, enough, in fact, to prevent the passage of a waggon, for which such "rides" are not intended. Many *such* glades might be made with advantage to the beauty of the Forest and to its safety from Forest fires; but it is seldom desirable to run them for more than 200 yards or so in a straight line.

We next crossed an open space of another type, known as Ludgate Plain, a somewhat swampy tract, with a stream running through it. Considering that we have just experienced an unusually wet season, I do not think this a spot that calls for artificial drainage, though the natural watercourse might be kept clear. I should advocate the diversifying of this and similar spots by the planting of clumps of Alder, a beautiful tree not common in the district. Such trees as this and species of Willow and Poplar would aid very much in preventing the accumulation of stagnant water. It was pointed out that young trees can be well notched in singly in the middle of a clump of Thorn, which will then serve as a protection against deer and cattle. At the same time masses of dead Bramble beneath the shade of grown trees are a source of danger from their inflammability, and should be removed.

Passing much open ground about Fairmead Bottom, we then entered the grand grove of Beeches at High Beach, and, after enjoying the view over the Lea Valley, drove to Theydon Thicks, in the hope of sighting some of the deer. The young Birches here form a most attractive feature, and the general feeling of our party seemed to be against any such introduction of exotics as that of *Rhododendron ponticum*, which

grows freely from self-sown seed in the beautiful Oak Hill Enclosure. We saw only the footprints of the deer on the bank of one of the most unsightly and unwarrantable "improvements" ever perpetrated. This was the cutting of what was once a swift, though winding, stream, dividing the manors of Theydon and Epping, into a square, straight, unsightly ditch. The Verderers, who from their local knowledge are entitled to a large share in the management of such matters, assured us that this ditch had not been authorised by them.

We then arrived at Ambresbury Banks, where our fears of over-felling were more completely realised than at any other point. Within this noble earthwork the Pollards were too thick in places; but a wholesale clearing had been effected, including many of the soundest trees, in some places three or four together, and not only within but upon the *vallum*, so that its surface will be unnecessarily exposed to rapid denudation by the rain.

Walking next from the "Wake Arms" across some heathery waste of extreme beauty, which one would hardly wish to reduce in area by planting, we followed the deep-cut course of an efficient, though winding, natural watercourse, till we reached a hideous example of the ruin wrought by the reckless polling in the past—a grove mainly of Beech, once cut near the ground, so that their gnarled, diseased, and stunted stems sprang in groups of from three to twenty from a single stool. It had been estimated that, counting these separately, there were 1200 to the acre; but though certainly three out of four could well be spared, it would be doubtful if even the most careful selection of the healthiest and most picturesque of these Beeches would be of any use, so thoroughly are they crippled. I am inclined to doubt whether they will ever run up into the monotonously vertical branches which we saw in a wood of Hornbeam near Little Monk Wood, which, having escaped the last lopping-rotation before the abolition of this right, have been uncut for about thirty years, and exhibit the condition which Hawkwood is approaching. It is, however, doubtful whether selected trees, even from among these, would not feather out in a drooping manner if allowed room and light and re-pollarded.

Crossing Sandpit Plain—a bare strip that might be much improved by clumps of Holly, Cherry, Crab, or other trees—we saw on our left some fallow fields on the outskirts of Loughton that would be the better for being entirely planted, not being, like Chingford Plain, of any real use in their present condition.

A backward glance of regret at a long, broad, stiff, straight, and unsightly clearing, called a "green ride," perpetrated soon after the Corporation got possession, and a parting laugh at a brick-built waterfall, over which the water no longer falls, and which may soon be mercifully destroyed, were our last glimpses of the Forest.

The chief conclusions to which I have come with reference to the management of the Forest are:—

1st. That it is to be regretted that, during five years' occupation, the Conservators should have done practically no planting. 2nd. That, though perhaps it may have been necessary to make and repair certain roadways and to clear "rides" through the Forest, no more roads are now required; that the "rides" have been cut too straight, and that any additional ones, requisite for the prevention of forest fires or merely for beauty, should be far less formal. 3rd. That, seeing the many natural watercourses of the Forest, after the experience of unusually wet seasons, it appears that no more drainage is required, but that the planting of Alder, Willows, Poplars, and other trees, will be a more natural way of rendering the surface drier. 4th. That, though much felling undoubtedly

has been, and is, desirable as a step towards replacing decrepit Pollards by healthy trees with room for the development of their beauty, over-felling has occurred locally; want of judgment in selection has been shown generally; trees felled might have been temporarily preserved as nurses to seedlings; and, in view of other more pressing operations, more felling may be postponed. 5th. That, though it is to be regretted that the commoners' rights of pasturage were not redeemed as were those of lopping, it is quite feasible to make small and local enclosures not only for re-afforestation, but also for small nurseries; and 6th. That planting should occupy the main attention of the staff in the immediate future, and that the species indigenous to the Forest afford sufficient variety to render the introduction of others unnecessary.

The trees now on the Forest include more than thirty forms; whilst the Linden, the Guelder Rose, the Yew, and the Juniper grew there in Warner's time—*i. e.*, a century back; the Scotch Fir was then "self-sown in the great pond at Snaresbook," and the Spanish Chestnut was planted a hundred years before in the time of Ray.

Among trees and shrubs that I consider it desirable to increase are the Lime, the Maple, the Spindle Tree, the Bullace, the Plum, the Sloe, the Bird and Gean Cherries, the Hawthorn, the Pear, the two varieties of Crab, the Mountain Ash, the Service, the Cornel, the Danewort, the Guelder Rose, the Holly, the Ash, Elms, Poplars, the Birch, the Alder, the Beech, the Oak, the Hornbeam, the Yew, and the Juniper.

G. S. Boulger.

APPENDIX.—No. 2.

REPORT OF THE COUNCIL AND BALANCE SHEET FOR 1882;

ADDITIONS TO THE LIBRARY;

LIST OF MEMBERS, &c.

Corrected to February 24th, 1883.

ESSEX FIELD CLUB,

BUCKHURST HILL.

Dr. TREASURER'S STATEMENT OF ACCOUNT FOR THE YEAR ENDING 31ST DECEMBER, 1882. *Cr.*

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Balance fron 1881		29 18 11	By Printing 'Transactions' (Parts 5 and 6) and Cost of Engravings		125 13 6
,, Subscriptions, 1880	2 12 6		,, General Expenses :—		
,, ,, 1881	16 1 0		Printing Notices, Tickets, &c.	24 5 1	
,, ,, 1882	119 18 6		Stationery, &c.	0 8 3	
,, ,, 1883	14 15 6		Sundry Expenses, Insurance, &c.	8 3 10	
		153 7 6			32 17 2
,, Donation to Publication Expenses (Mr. Baring, M.P.)		10 0 0	,, Expenses of Museum, Library, and Binding		12 13 0
,, Sale of Publications		5 15 1	,, Expenses at Field Meetings		19 18 7
,, Receipts at Field Meetings		18 8 11	,, Postages		15 12 11
,, Subscriptions to "Tea Fund"		3 10 6	,, Collector's Commission on Income in 1882		3 16 8
			,, Expenses charged to "Tea Fund"		2 9 1
			,, Balance :—		
			Cash in hands of Secretary	5 0 0	
			,, ,, Collector	1 16 2	
			,, ,, Treasurer	1 3 10	
					8 0 0
December 31st, 1882.—To Balance....£8 0 0		£221 0 11			£221 0 11

LIFE COMPOSITION ACCOUNT.

To Balance from 1881	19 5 6	By Cost of Cabinet, paid on account		10 0 0
,, Three "Life Compositions" received in 1882	15 15 0	,, Balance		25 0 6
December 31st, 1882.—To Balance....£25 0 6	£35 0 6	Liability.—To complete purchase of Cabinet....£10 0 0		£35 0 6

FOREST CAMP EXPLORATION FUND, 1882.

To Balance from last account	5 11 2	By Expenses of Excavating (Mr. Cuthbert)		35 0 0
,, Subscriptions received in 1882	63 7 6	,, Sundry Expenses		14 4 1
		,, Sum set apart for publication of "Report"		15 0 0
December 31st, 1882.—To Balance	£3 2 11	,, Collector's Commission on Subscriptions		1 11 8
,, British Association Grant	10 0 0	,, Balance		3 2 11
,, Unpaid Subscriptions	3 3 0			
	£16 5 11			£68 18 8
	£68 18 8			

ASSETS.

To Balance in hand, Genera Account	8 0 0
,, Balance of "Camp Fund"	3 2 11
,, Grant from British Association, January, 1883	10 0 0
,, Sum set apart for publication of Report on Camps	15 0 0
,, Balance of Life Composition Fund	25 0 6
,, Unpaid Subscriptions .... £53 18 0 considered good (say)	30 0 0
,, Estimated value of Furniture (say)	50 0 0
,, Estimated value of Stock of 'Transactions' (say)	25 0 0
,, Unpaid Subscriptions to Camp Fund (good)	3 3 0

LIABILITIES.

Liability.—Life Composition account To complete purchase of Cabinet (paid in 1883)	10 0 0
Other Liabilities....*nil.*	

REPORT OF THE COUNCIL FOR THE YEAR 1882.

[*Read at the Third Annual General Meeting, held at Buckhurst Hill, January 27th, 1883.*]

In accordance with the Rules, the Council has pleasure in presenting the 3rd Annual Report.

The past year has proved a somewhat memorable one in the history of the Club. Not only has the Society increased in numbers, but the scientific assistance given to it, and the work done, have been of a solid and interesting nature.

During the year 2 honorary members and 60 ordinary members were elected, of whom 3 have compounded for their annual subscriptions; 13 members have resigned; 8 members have been removed for non-payment of subscriptions for two years or upwards, and two deaths have occurred. Although the work of Mr. Charles Darwin will form a large part of the subject-matter of the address from the chair, the Council may be here permitted to record its deep sense of the loss sustained by science in the death of our illustrious honorary member.

The census of the Club at the end of the years 1881 and 1882 was therefore as follows:—

	1881.	*1882.*
Patron	1	1
Honorary members	9	10
Life members	10	13
Ordinary members	295	330
	315	354

The net increase thus shown falls very short of that of the previous year, but the large accessions in 1881 were, of course, exceptional, being connected with the recent establishment and success of the Society. The Council has put in force the rule as to forfeiture of membership for non-payment of subscription against eight members, but as these have never contributed to the funds their expulsion cannot be considered a loss to the Society.

A voluminous part of the 'Transactions' (completing the second volume) was published in July, comprising, with appendices, 200 printed pages and one folding plate. Fifty-one woodcuts also illustrated the part, of which 17 were engraved at the expense of the Club, 31 were kindly lent by Messrs. West, Newman, and Co., two by Miss Ormerod,

and one by the Editor of the 'Gardeners' Chronicle.' The Council has authorised the Editor to use in future on all issues of the Club the short title, "The Essex Field Club," the longer title being a constant source of misquotation and misapprehension.

A considerable number of valuable papers still remain in hand, but the Council confidently anticipates, with the kind assistance and sympathy of members and friends, to be in a position to clear off the arrears and increments during the coming year. Mr. T. C. Baring, M.P., has very generously presented the sum of £10 towards publication expenses, and it is suggested that those members willing and able to do so should increase their annual subscription to the Club, in order to furnish additional funds for printing and for adequate illustration of memoirs. These matters are referred to in the President's Address.

The financial position of the Society is fairly good, a small balance being carried forward, while no liabilities remain undischarged. The Council is reluctantly compelled again to point out the great inconvenience occasioned by the non-payment of subscriptions *early in the year*. The work of the officers is thereby largely increased, and the efficiency and potential energy of the Society proportionately diminished.

The number of volumes in the Library has almost doubled during the year, without including some valuable additions which are not yet bound. The Club has now, in round numbers, about 300 books available for reference by members, but it is a matter for regret that the privileges of the Library have not been more extensively used. Possibly Mr. Fawcett's new Parcels Post, when introduced, may render feasible a scheme for the circulation of books by post, so as to enable all our members, far and near, to use the Library. Donations still continue to come in steadily, and there is every probability that the Library will, before long, become a valuable and useful one by presentations alone. While the thanks of the Society are due to all those who have aided in the good work, special acknowledgments must be made to Miss Saul, of Bow, who has given 20 consecutive annual volumes of the Palæontographical Society's magnificent monographs; also to the Council of the British Association for an almost complete set of the Association Reports, one or two of the annual volumes being out of print. As it will be somewhat expensive to bind these special accessions properly, they will be put upon the shelves by degrees. A considerable number of scientific journals continue to be placed at the disposal of the members, and are always on the Library table for reference. During the year Mr. W. Saville Kent's 'Manual of the Infusoria' has been purchased, and the Council proposes to subscribe to the Ray and Palæontographical Societies henceforward.

The Librarian will always be glad to receive donations of books, pamphlets, or periodicals of scientific interest; and literature of all kinds, maps, engravings, drawings, &c., relating to or published in the county of Essex. This last department is one of importance, as it is believed that no complete public collection of books illustrating Essex is in

existence, and to form one would be a task well worthy of the ambition of a local Society.

As will be seen by the 'Journal of Proceedings,' the county collections of the Club have been increased during the year, but not to the extent anticipated or desired. Mr. Harcourt's donation of a collection of dried flowers from Epping Forest, preserved by Mr. English's process, deserves special notice. Six cases have been received, and the others will be delivered as ready. Mr. Hope's presentation of specimens of Essex birds, and Miss Ridley's collection of British ferns, also call for grateful acknowledgment. The Council has purchased a first-rate insect cabinet of 30 drawers, at a cost of £20, but ornithological, botanical, geological, and other cabinets are urgently needed to receive the specimens in hand and those which are promised. A full statement of the wishes and needs of the Curators will be published during the ensuing spring.

Nine ordinary and seven field and other meetings have been held, at which average attendances have been shown of about 32 and 40 respectively. The Council is very desirous of increasing the interest of the meetings by encouraging exhibitions, &c., and asks for the cordial aid of members in this way. A few suggestions will be put forward shortly, which it is hoped will have the desired effect. At the seven field meetings the Society has had the benefit of the guidance and knowledge of the following gentlemen, acting as Referees or Conductors, and to whom the Council begs to offer its most grateful thanks:—Professor Boulger, Dr. Cooke, Canon Du Port, Messrs. James English, E. M. Holmes, T. V. Holmes, Andrew Johnston, and Saville Kent, Professor Morris, Messrs. C. B. Plowright, W. W. Reeves, N. F. Robarts, Worthington Smith, F. C. J. Spurrell, Fisher Unwin, Henry Walker, and Dr. Wharton. Special acknowledgments are also due for the honour conferred upon the Club by Professor Owen, General Pitt-Rivers, and Dr Woodward in taking upon themselves the tasks of expositors and lecturers at the meetings held at the British and South Kensington Museums on April 1st and May 13th. The Rev. W. Linton Wilson and Mrs. Wilson, with their accustomed hospitality, again entertained the Club at Chigwell on July 22nd, on which occasion also a refection was provided at the Luxborough Fruit Farm, by the kindness of Messrs. Meldola and W. Cole. The annual Cryptogamic Meeting of 1882 was one of the most successful assemblies hitherto held by the Club, and it is hoped that the "Loughton Fungus Foray" will become a popular and permanent *réunion* of London botanists. Saturday, September 29th, has been chosen as the date of the "Foray" for 1883.

Various local newspapers have again aided the Club by reporting meetings and in other ways. Special thanks are due to the editors of the 'Essex Times,' 'Chelmsford Chronicle,' and 'Essex Weekly News.'

The Council cannot but feel that the field meetings form a most important part of the work of the Club, and that every effort should be

made to render them popular and interesting. Offers of aid, and suggestions as to places to be visited, will always be gladly received.

The Council has under consideration the advisability of fixing a few field meetings on days other than Saturdays, in order to meet the views of members to whom Saturday meetings are inconvenient.

As promised in the last Annual Report, the investigations at the Forest Camps were renewed in 1882. A circular was issued in February last, asking for funds to carry on the works. A very liberal response was made to that appeal, the following subscriptions being promised in the course of a few weeks:—

	£	*s.*	*d.*		£	*s.*	*d.*
Balance from last subscription	5	11	2	Lockyer, A.	0	10	6
Barnes, R. L.	0	10	6	Lubbock, Sir J.	2	2	0
Boulger, Professor	0	10	6	Meldola, R.	2	2	0
Buxton, E. N.	10	0	0	Melles, W.	5	0	0
Buxton, Sir Fowell	10	0	0	Owen, J.	0	10	6
Cole, B. G.	0	10	6	Pitt-Rivers, General	2	0	0
Cole, W.	1	1	0	Powell, N.	5	0	0
Cory, Dr.	0	10	6	Ramsden, H.	3	3	0
Crouch, W.	0	10	6	Robarts, N. F.	0	10	6
Darwin, Charles	2	2	0	Smith, W. G. S. (1881 subscription)	0	10	6
Dunning, J. W.	1	1	0	Spicer, A.	1	0	0
Francis, Rev. J.	1	0	0	Unwin, T. F.	0	10	6
Godwin, G. J.	0	10	6	Varley, F. H.	0	10	6
Grut, F.	0	10	6	Walker, Hy.	1	1	0
Harcourt, G. C.	0	10	6	Wilson, Rev. W. L.	1	1	0
Heathfield, E.	0	10	6	Winstone, B.	2	2	0
Hore, J. P.	2	2	0	Winter, Mrs.	0	10	0
Johnston, A.	3	3	0	British Association Grant	10	0	0
Letchford, R.	1	1	0				
Lister, A.	1	1	0		£82	1	8
,, (2nd subscription)	1	1	0				

With these funds the Council was enabled to commence work at the Loughton Camp on the 29th of May, and the investigation was continued for 14 days, under the superintendence of the Sub-Committee of the Club. A preliminary report of the work done was presented at the Southampton meeting of the British Association (and has been published in the Association Report), when the Committee of last year was re-constituted, with the addition of Mr. Worthington G. Smith. A grant of £10 was at the same time made towards the expenses. After a rough examination of the results of the fortnight's work, it was considered desirable that further search should be made, and a second series of diggings was begun on Monday, August 14th, and continued the whole week. The evidence thus obtained has not yet been fully collated, and some surveying and other work remains to be done, but the Committee hopes to be ready with a full report early in the ensuing summer for presentation to the British Association and publication in the 'Transactions' of the Club. A sum of £15 has been set apart for the due illustration of the report. The hearty thanks of the Club are due to those

gentlemen who, at a great expenditure of time, so carefully conducted the work, and also to General Pitt-Rivers and Mr. D'Oyley for renewed help and advice.

Pursuant to some suggestions thrown out in 1881, the Council organised two meetings at Grays, Essex, for the purpose of making some preliminary surveys of the curious "Dene-holes" in Hangman's Wood. Mr. Spurrell, Mr. T. V. Holmes, and Mr. Walker very kindly placed their valuable services at the Club's disposal, and Messrs. Brooks, Shoobridge, and Co. rendered all the assistance in their power in the supply of experienced men and machinery. It is unnecessary to recapitulate the work done at these meetings, as full particulars are given in Mr. Holmes's paper and in the 'Proceedings.' So much interest has been excited among our members and the general public as to the exact nature and origin of the "Denes," that the Council has resolved to undertake their systematic exploration. The Lewisham and Blackheath Scientific Association has, with great generosity, voted the sum of £5 in aid of the proposed work. Mr. T. V. Holmes has promised £5 5*s.*; Mr. Meldola £5 5*s.*; Professor Boulger £3 3*s.*; Mr. Henry Walker £2 2*s.*; and Mr. Letchford £2 2*s.*; but as the necessary works will be very costly, additional aid is asked from all interested in archæological research. Captain Wingfield, the owner of Hangman's Wood, and Mr. Biddell, his agent, have most courteously given the Club full permission to carry on a thorough exploration. The Council hopes to be in a position to commence early in the summer, as soon as the Forest Camp Exploration Report is completed.

The President and Mr. John Spiller, F.C.S., again attended the Conference of Scientific Societies held on August 25th, during the Southampton meeting of the British Association, as Delegates from the Club. A report of that meeting has been published and circulated by the Conference, and the principal matters discussed are referred to in Mr. Meldola's annual address.

Early in the year the condition and mode of conservation of Epping Forest again gave rise to some anxiety, and attracted a considerable amount of public attention. In February last the Club held a meeting, at which the matter was fully discussed, as well as the cognate subject brought forward by Sir Fowell Buxton (one of the Verderers of the Forest), that some means should be adopted for the protection of our native birds and animals from wanton destruction. As an outcome of that meeting a full report of the discussion has been prepared, and will shortly be issued as an Appendix to Volume III. of the 'Transactions,' together with three suggestive papers prepared at the request of the Council by Dr. Cooke, Professor Boulger, and Mr. Harting. The co-operation of the Natural History Societies of London and its neighbourhood was solicited, and a form of "Protest" prepared by the Club has been extensively signed and approved. The Council proposes to print 1000 copies of the memorial for circulation, and is sanguine enough to

hope that the statements and reasoning therein contained will carry conviction, and instil something of the "quality of mercy" towards our dumb companions into the minds and hearts of game-keepers, landowners, and those having the custody of open spaces.

The dismal picture of another railway will haunt the minds of well-wishers of the Forest during the next few months, the Great Eastern Company having resolved to push on their Bill for a line from Chingford to High Beach, across a portion of this beautiful woodland, during the ensuing Session of Parliament. The Society will be afforded an opportunity of expressing its opinion on the matter at the annual meeting.

The Council cannot permit Mr. Meldola to vacate the chair he has so ably filled during the three years' existence of the Club without publicly expressing its deep sense of the services he has rendered to the Society. Much of the success of the Club has been due to the earnest and scientific tone imparted to its discussions and operations by the President, and Mr. Meldola's courteous and constant attention to the very exacting claims of his office has been beyond praise. His various addresses at the meetings have afforded valuable guidance in the past as to the action and methods of the Society, and the Council is assured that nothing could more conduce to the future prosperity and usefulness of the Club than a steady adherence to the scientific aims and firmness of purpose so uniformly advocated by the retiring President.

The Council has again pleasure in thanking Miss Jane Cole and Mr. H. A. Cole for the use of the rooms occupied by the Club.

Although not a matter officially connected with the Society, the Council is of opinion that the kindness of those members who have afforded means to supply tea, coffee, and light refreshment at the ordinary meetings deserves grateful notice. Many of the members coming from long distances to attend the meetings have much appreciated this thoughtful attention.

PAST PRESIDENT.

1880—82. RAPHAEL MELDOLA, F.R.A.S., F.C.S., M.A.I., &c.

ADDITIONS TO THE LIBRARY.

(April, 1882, to February, 1883.)

Anon. An Abridged Catalogue of the Saffron Walden Museum. 8vo. Saffron Walden, 1845. [*From Mr. R. M. Christy.*]

———. Croydon to the North Downs. A Handy Guide to Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Dorking and Neighbourhood. A Handy Guide to Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Easy Lessons in Botany. According to Requirements of Revised Code, 1880. 2nd edition. Small 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. England Illustrated. Essex. 4to. 1764. [*From Mr. P. F. Copland.*]

———. Ferns and Ferneries. 8vo. London, 1880. [*From Mr. T. F. Unwin.*]

———. Geological Rambles round London. A Handy Guide to Old-world London. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Greenwich and Blackheath, with Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Plant-Life. Popular Papers on the Phenomena of Botany. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Round Bromley and Keston. A Handy Guide to Rambles in the District. 8vo. London, n.d. [*From Mr. T. F. Unwin.*]

———. Round Reigate. A Handy Guide to Walks in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Round Richmond. A Handy Guide to Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Round Tunbridge Wells. A Handy Guide to Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

———. Sydenham, Dulwich, and Norwood. A Handy Guide to Rambles in the District. 8vo. London, n.d. [*From Mr. T. F. Unwin.*]

———. The Wild Birds' Protection Act, 1880, with Explanatory Notes. 43 and 44 Vict., cap. 35. Small 8vo. London, 1880. [*From Mr. J. E. Harting.*]

Antiquarian Magazine and Bibliographer. Vols. i., ii. 8vo. London, 1882. [*From Mr. T. F. Unwin.*]

Berwickshire Naturalists' Club. History, 1879—81. Alnwick, 1882. [*From the Society.*]

Botany, Journal of. New series. Vol. xi. 8vo. London, 1882. [*From Mr. R. L. Barnes.*]

Bristol Naturalists' Society. Proceedings. New series. Vol. iii. 8vo. Bristol, 1882. [*From the Society.*]

Cooke, Dr. M. C. Grevillea Atlas, consisting of thirty-seven Coloured Plates of Hymenomycetal Fungi. 8vo. London, 1882. [*From the Author.*]

———. The Myxomycetes of Great Britain. Arranged according to the Method of Rostafinski. 8vo. London, 1877. [*From the Author.*]

Derham, Rev. W. Physico-Theology: or a Demonstration of the Being and Attributes of God, from the Works of Creation. 12th edition. 8vo. London, 1754. [*From Mr. R. Meldola.*]

Entomologist. Vol. xv. 8vo. London, 1882. [*From Mr. P. F. Copland.*]

Entomologist's Monthly Magazine. Vol. xviii. 8vo. London, 1882. [*From Mr. B. G. Cole.*]

Essex Field Club. Transactions. Vol. ii. 8vo. Buckhurst Hill, 1882. (Two copies.)

Essex Institute. Bulletin. Vol. xiii. 8vo. Salem, Mass., 1882. [*From the Society.*]

Frost, Thomas. Kingston-on-Thames, with Rambles in the District. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

Glasgow, Philosophical Society of. Proceedings. Vol. xiii. 8vo. Glasgow, 1882. [*From the Society.*]

Hertfordshire Natural History Society and Field Club. Transactions. Vol. i. 8vo. London, 1882. [*From the Society.*]

Houston, David. Practical Botany for Elementary Students. Introductory to the systematic study of Flowering Plants. 8vo. London and Edinburgh, 1880. [*From Mr. W. Mawer.*]

Kent, W. Saville. A Manual of the Infusoria: including a Description of all known Flagellate, Ciliate, and Tentaculiferous Protozoa, British and Foreign, and an Account of the Organization and Affinities of the Sponges. 3 vols. Large 8vo. London, 1882. [*Purchased.*]

Land and Water. [*From Mr. R. Meldola.*]

Low, Professor D. On the Domesticated Animals of the British Islands: comprehending the Natural and Economical History of Species and Varieties; the Description of the Properties of External Form; and Observations on the Principles and Practice of Breeding. 8vo. London, n.d. [*From Mr. W. White.*]

Lubbock, Sir J. Ants, Bees, and Wasps. A Record of Observations on the Habits of the Social Hymenoptera. 8vo. New York, 1882. [*From Mr. R. L. Barnes.*]

Macgillivray, W. Lives of Eminent Zoologists, from Aristotle to

Linnæus: with Introductory Remarks on the Study of Natural History, and Occasional Observations on the Progress of Zoology 2nd edition. Small 8vo. Edinburgh and London, 1834. [*From Mr. B. G. Cole.*]

Manchester Geological Society. Transactions. Vol. xvi. 8vo. Manchester, 1882. [*From the Society.*]

Midland Naturalist. Vol. v. 8vo. London, 1882. [*From Mr. A. Lockyer.*]

Naturalist. New series. Vol. vii. 8vo. Huddersfield, 1882. [*From the Editors.*]

Nature. Vols. xxv., xxvi. Large 8vo. London, 1882. [*From Mr. H. J. Barnes.*]

Northampton Natural History Society. Journal. Vol. i. 8vo. Northampton, 1880—81. [*From the Society.*]

Palin, Rev. W. Stifford and its Neighbourhood, Past and Present. 8vo. Printed for Private Circulation, 1871. [*From Mr. A. Johnston.*]

———. More about Stifford and its Neighbourhood, Past and Present. 8vo. Printed for Private Circulation, 1872. [*From Mr. A. Johnston.*]

Pascoe, F. P. Zoological Classification. A Handy Book of Reference, with Tables of the Sub-kingdoms, Classes, Orders, &c., of the Animal Kingdom, their Characters, and Lists of the Families and Principal Genera. Small 8vo. London, 1877. [*From Mr. J. E. Harting.*]

Pearce, Dr. C. T. Vital Statistics. Small-pox and Vaccination in the United Kingdom of Great Britain and Ireland and Continental Countries and Cities, with Tables compiled from Authentic Sources. 8vo. London, 1882. [*From the Author.*]

Plymouth Institution and Devon and Cornwall Natural History Society. Annual Reports and Transactions. Vol. vii. Plymouth, 1881. [*From the Society.*]

Ray, John. Miscellaneous Discourses concerning the Dissolution and Changes of the World. 8vo. London, 1692. [*From Mr. B. G. Cole.*]

Roberts, George. Topography and Natural History of Lofthouse and its Neighbourhood; with the Diary of a Naturalist and Rural Notes. 8vo. London and Leeds, 1882. [*From Mr. J. E. Harting.*]

Romanes, Dr. G. J. The Scientific Evidences of Organic Evolution. 8vo. London, 1882. [*From Mr. W. White.*]

Royal Microscopical Society. Journal. 2nd series. Vol. ii. 8vo. London, 1882. [*From Mr. W. Emmens.*]

Science Gossip. Vol. xviii. 8vo. London, 1882. [*From Miss Cole.*]

Scottish Naturalist. Vol. vi. 8vo. Edinburgh and London, 1881—82. [*From the Perthshire Society of Natural Science.*]

Storer, Rev. J. The Wild White Cattle of Great Britain. An Account of their Origin, History, and Present State. Edited by his son, John Storer. 8vo. London, n.d. [*From Mr. P. F. Copland.*]

Walker, Rev. F. A. A History of the Parish of Dry Drayton, in the

Rural Deanery of Chesterton, County of Cambridge, and Diocese of Ely. Small 8vo. London, 1876. [*From the Author.*]

Walker, Rev. F. A. L'Orient: or, a Journal of my Tour in the East, March 1st—June 30th, 1882. 8vo. London, 1882. [*From the Author.*]

Weston, James. The Fresh-water Aquarium. 8vo. London, 1881. [*From Mr. T. F. Unwin.*]

Withering, William. An Arrangement of British Plants, according to the latest Improvements of the Linnæan System; with an easy Introduction to the Study of Botany. Sixth edition. Four vols. 8vo. London, 1818. [*From Mr. W. Cole.*]

Zoologist. Third series. Vol. vi. 8vo. London, 1882. [*From Mr. R. L. Barnes.*]

Pamphlets. Vol. iv. Geology. 8vo.

Contents:

Crosskey, Rev. H. W. Ninth Report of the Committee for Recording Erratic Blocks. (*Rep. Brit. Assoc.*, 1881.)

———. Tenth ditto. (*Ib.*, 1882.)

Dakyns, J. R. Glacial Beds at Bridlington. Leeds, 1879.

———. On Silurian Erratics in Wharfedale. Leeds. [1877.]

Etheridge, Robert. Address to the Geological Section of the British Association. (*Rep. Brit. Assoc.*, 1882.)

Foster, C. le Neve. On the Occurrence of Cobalt Ore in Flintshire. (*Trans. Roy. Geol. Soc., Cornwall*, 1881.)

Jukes-Browne, A. J. The Post-Tertiary Deposits of Cambridgeshire. Cambridge and London, 1878.

Lamplugh, G. W. On the Divisions of the Glacial Beds in Filey Bay. Leeds, 1879.

Morris, Professor J. A List of British Fossils, stratigraphically and zoologically arranged. London, n.d.

———. Geological Notes on Parts of Northampton and Lincolnshires. (*Geol. Mag.*, 1869.)

———. On the Genus *Æchmodus* from the Lias of Lyme Regis. (*Ib.*)

———. The Lead-bearing Districts of the North of England. (*Ib.*)

———. The Physical Structure of the London Basin, considered in its relation to the Geology of the Neighbourhood of Watford. (*Trans. Watford Nat. Hist. Soc.*, 1876.)

Peach, B. N., and John Horne. The Glaciation of the Shetland Isles. (*Quart. Journ. Geol. Soc.*, 1879.)

Ricketts, Dr. C. On Split and other Boulders. (*Proc. Liverpool Geol. Soc.*, 1880—81.)

Rutot, M. A. Compte Rendu de l'Excursion de la Société Géologique de Belgique dans les Environs de Bruxelles, 5—7 Sept., 1880. Liége, 1881.

———. Sur la Position stratigraphique des Restes de Mammifères Terrestres recueillis dans les Couches de l'Eocène de Belgique. Bruxelles, 1881.

Teale, J. J. H. The Potton and Wicken Phosphatic Deposits. Cambridge and London, 1875.

Ussher, W. A. E. On the Geology of Parts of Devon and West Somerset north of South Molton and Dulverton. (*Proc. Somerset Archæol. and Nat. Hist. Soc.*, 1879.)

———. Pleistocene Notes on the Cornish Coast, between Plymouth and Looe. (*Trans. Roy. Geol. Soc., Cornwall*, 1881.)

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ERRATA IN THIS PART.—Page 73, the reference number to note 7 belongs to age 72, line 8 from bottom, after the word "Species." Page 93, line 4 from top, or "intermediate" *read* "immediate." Page xxxi, line 8 from bottom, for "*averne*" *read* "*averni*." Page lx, line 7 from bottom, for "Sir R. Airy" *read* "Sir G. B. Airy."

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TRANSACTIONS

OF

THE ESSEX FIELD CLUB.

Vol. IV.

TRANSACTIONS

OF THE

ESSEX FIELD CLUB.

EDITED BY

WILLIAM COLE, HONORARY SECRETARY.

VOLUME IV.

"*Come forth into the light of things,*
Let Nature be your teacher."—WORDSWORTH.

THE AUTHORS ONLY ARE RESPONSIBLE FOR THE STATEMENTS AND OPINIONS CONTAINED IN THEIR RESPECTIVE PAPERS.

PUBLISHED BY THE CLUB,
BUCKHURST HILL, ESSEX.

1886.

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Errata.

Page 88, Fig. 1. The shaft in this drawing is somewhat too large, the apex of the heap of *débris* is not under centre of shaft, and the lateral chambers are shown as being rather too near the shaft.

Page 90, line 2. *For* "marked," *read* "mark."

Page 96, lines 2, 6, and 13. *For* "Witchling," *read* "Wichling."

[*Notice to Readers and Librarians.*—It should be noted that the first three volumes of the 'Transactions' included also the 'Proceedings,' which formed an integral part of each volume, but with a distinct pagination. In Volume IV. a different plan was adopted; the 'Transactions' and 'Proceedings' were issued separately, and form distinct volumes. The first series consists therefore of *five volumes* in all, *viz.*, 'Transactions,' Vols. I.—IV. (the first three including 'Proceedings'), and 'Proceedings,' Vol. IV. The *new series* under the title of 'The Essex Naturalist' *commences in January, 1887.*—Ed.]

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IMPORTANT ANNOUNCEMENT RESPECTING THE PUBLICATIONS OF THE CLUB.

I VERY gladly announce that, after careful consideration and consultation with the most active members of the Club, the Council has decided to make a bold alteration in the mode of issuing our publications. In future the 'Transactions' and 'Proceedings' of the Club will be combined in the form of a monthly periodical, under the title of 'THE ESSEX NATURALIST, BEING THE JOURNAL OF THE ESSEX FIELD CLUB.'

The 'Essex Naturalist' will contain PAPERS read before the Club, or which may otherwise be placed in the Editor's hands, REPORTS OF MEETINGS of the Club, and, as space allows, a special feature will be SHORT NOTES, treating of the Natural History, Geology, and Pre-historic Archæology of Essex, so that the journal may serve as a medium for inter-communication between the members on subjects included in the programme of the Society. NOTICES of BOOKS, and other publications concerning Essex, will also appear from time to time, and it is hoped that the journal, when fully developed, will form an interesting register of the scientific activity of the county, whilst serving its primary purpose of keeping the members of the Essex Field Club promptly informed of all club news and proceedings.

I am sanguine enough to think that the change will not only increase the interest of our members in the doings of the Club, but will greatly extend its usefulness as a practical Society; and by encouraging an inflow of new members, will ultimately add considerably to the scientific and financial resources of the institution.

In the duty of conducting our monthly periodical, I rely upon the ready help and encouragement of all well-wishers of the Club, and of all who are desirous of extending a love of natural history studies and amusements in Essex, and among the dwellers in the eastern environs of London. The five volumes of 'Transactions' and 'Proceedings' now completed, together with the 'Report on the East Anglian Earthquake' (*the first book of the kind ever published in England*), form a record of work accomplished during the yet short life of the Club, upon which our members may justly be congratulated, and work which has added very considerably to the advancement of natural knowledge in Essex. I trustfully hope that the Essex Field Club will not lose the position it has gained, and that the 'Essex Naturalist' will be one agency at least by means of which the influence and credit of the Society may be enhanced in the time to come.

WILLIAM COLE,
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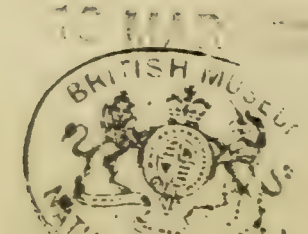
BRITISH MUSEUM

to the statement on back of cover relating to change in mode of publication of the 'Transactions' and 'Proceedings.'

Vol. IV.] JUNE, 1885. [Part 1.

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Edited by William Cole, Honorary Secretary.

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THE ESSEX FIELD CLUB.

I.

THE PRESIDENTIAL ADDRESS; DELIVERED BY PROFESSOR G. S. BOULGER, F.L.S., F.G.S., F.R.M.S., AT THE ANNUAL MEETING, JANUARY 26TH, 1884.

LADIES AND GENTLEMEN,

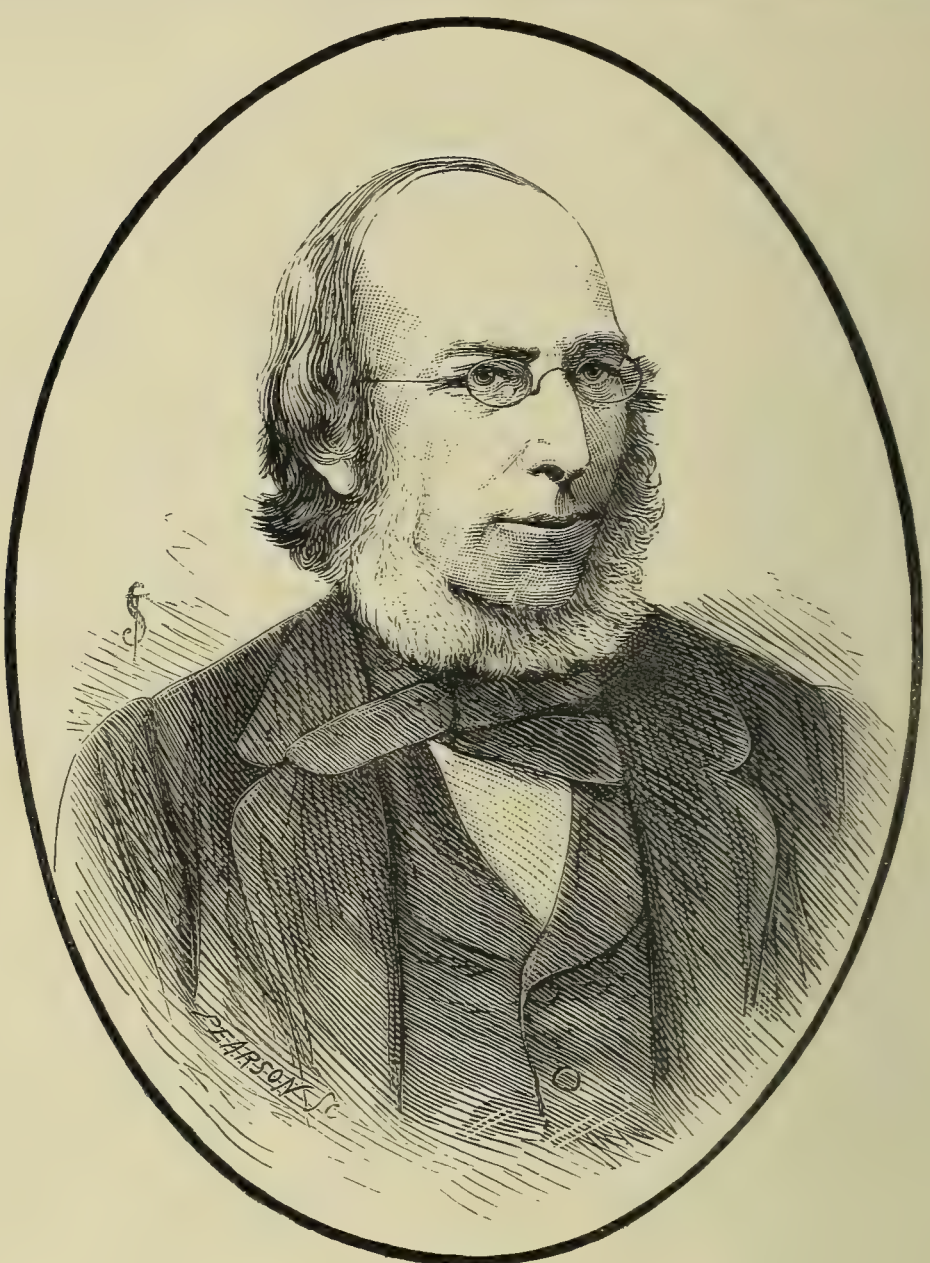
SINCE our last Annual Meeting, when you did me the honour to elect me to this chair, I think I may say that the Club has experienced a year of life that may fairly be termed successful. The nett increase in our numbers is satisfactory; but I would impress upon you the importance of still further enlisting the sympathies of residents in the county, especially in its more remote parts. Unable to attend our meetings, and in some cases beyond the range of the Field Meetings we have as yet attempted, it is by our publications that we must appeal to this wider constituency, in order that we may with their aid more completely represent the county, and come to be, in the words of our late circular, "looked upon as the Scientific Registry Office for the county."

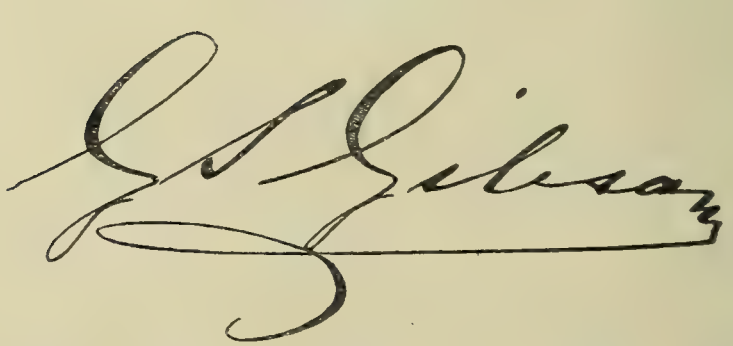
We have had to deplore the loss by death during the year of Mr. G. S. Gibson, of Mr. J. E. Howard, and of Dr. Charles T. Pearce, the latter a frequent attendant at our meetings, well known as an opponent, I regret to say, of vaccination.

GEORGE STACEY GIBSON[1] was born on July 20th, 1818, at Saffron Walden. He was the only child of Wyatt George

[1] [The photograph from which the portrait is taken was kindly lent to the Editor for the engraver's use by Mrs. Gibson.—ED.]

Gibson and his wife Deborah, daughter of George Stacey, of Alton, Hampshire, his father's family being mainly from the North of England, and connected with those of Middlebrooke, Johnson, and Atkinson, from the neighbourhood of Doncaster,





Wilson of Kendal, and Wyatt, Mr. Gibson being lineally descended from Sir Henry Wyatt, the father of the poet. His branch of the Gibson family migrated into Essex, from

Norfolk, about 125 years back; and, though another branch was previously settled at Great Chesterford, the great grandfather of the late author of the 'Flora of Essex,' George Gibson, for fifty-two years a minister of the Society of Friends, was the first of the family to live in Saffron Walden, coming there from Maldon.

Born to ample private means, though occupied during much of his life by the cares of a large business, and of many municipal, charitable, and religious institutions, Mr. Gibson seems to have imbibed at an early age a love of Nature, which, as in the case of many of his most eminent co-religionists, was mainly directed to Botany. He seems, when little more than twenty, to have become so well acquainted with our British flora that his keen powers of observation added several species not only to the known flora of Essex, but also to that of the British Isles. His additions to our Essex list were fifteen in number—viz., *Fumaria parviflora* (1841), *Alsine tenuifolia* and *Cuscuta trifolii* (1842), *Filago spathulata*, *Crepis setosa*, and *Cuscuta epilinum* (1843), *Galium vaillantii* (1844), *Fumaria vaillantii* (1845), *Carex fulva* (1846), *Poterium muricatum*, *Melampyrum arvense*, and *Thesium humifusum* (1849), *Vicia gracilis* and *Geum intermedium* (1859), and *Galium parisiense* (1860). Of these, *Cuscuta trifolii*, *Crepis setosa*, *Filago spathulata*, and *Galium vaillantii* were new to Britain, as were also *Arenaria uliginosa*, found in Yorkshire in 1844, and *Potentilla norvegica* from Cambridgeshire in 1868.

Of these latter most were recorded in the pages of the first series of the 'Phytologist,' his contributions to which were as follows:—To vol. i. (1841–44), p. 408, "A Flora of the Neighbourhood of Saffron Walden," 1842, containing *Cuscuta epithymum?* which afterwards proved to be *C. trifolii;* p. 466, "Additional Observations to a 'Note on a supposed New British *Cuscuta*, by C. C. Babington,' (*C. trifolii*)," January, 1843; p. 735, "Rarer Plants observed near Weymouth," August, 1843; p. 757, "Rarer Plants observed near Weston-super-Mare," August, 1843; p. 758, "Rarer Plants found near Ventnor," August, 1843; p. 770, "Note on the New *Cuscuta*," August, 1843; p. 817, "Notice of a Visit to Black

Notley," by Joshua Clarke and G. S. Gibson, October, 1843; p. 838, "Supplement to the List of Saffron Walden Plants," November, 1843, recording *Crepis setosa;* p. 902, "Notice on a *Carduus* found near Saffron Walden," January, 1843 (*C. dubius*, Willd.); p. 996, "Note on the *Primula elatior*," May, 1844, asserting its specific distinctness; p. 1123, "Additional Plants found about Saffron Walden during the Summer of 1844, with Remarks on some of the Species," October, 1844, recording *Galium vaillantii.* To vol. ii. (1845–47), p. 473, "Botanical Notes for 1845," containing records from Yorkshire and the Lake District; p. 676, "Notice of some Localities of Plants in Cornwall, &c., in the 8th Month, 1846"; p. 269, "*Crepis setosa* and *Atriplex hortensis* near Saffron Walden," September, 1847. To vol. iii. (1848–50), p. 216, "Notice of the Discovery of *Filago jussiæi* near Saffron Walden," July, 1848, now known as *F. spathulata;* p. 308, "Botanical Notes for 1848," recounting visits to Box Hill, Bottisham and Burwell Fens, and Newmarket, August, 1848; p. 540, "Mr. Newbould the discoverer of *Melilotus arvensis*," April, 1849; p. 707, "Botanical Notes for 1849," October, 1849. And to vol. iv. (1851–53), p. 64, "Botanical Notes for 1851," February, 1851, recording plants from Dunoon (printed Durroun), Argyleshire. In the 'Botanical Gazette,' vol. ii. (1850), is a letter from Mr. Gibson to Henfrey on *Fumaria vaillantii.* In 'English Botany,' Supplement, 2890, *Arenaria uliginosa* is stated to have been found in 1844 by a party of four, but the actual discoverer is believed to have been Mr. Gibson. Lastly, the finding of *Potentilla norvegica*, in Burwell Fen, Cambridgeshire, in 1868, was recorded in the 'Journal of Botany,' vi. (1868), p. 302.

In 1846 he communicated to Mr. Watson a list of West Cornish plants, which is incorporated in 'Topographical Botany,' where also records are acknowledged from Mr. Gibson for North Essex, Cambridge, East and West Norfolk, Surrey, West Sussex, North and South Devon, Monmouth, Radnor, Cardigan, Merioneth, Denbigh, North and West Yorkshire, Durham, and Perth.

As early as 1843, as we are told in the Preface, he "enter-

tained the thought of compiling a Flora of Essex, and wrote to several botanists on the subject, among others to Edward Forster, from whom he "learnt that he had already collected considerable materials for such a work, and had begun to arrange them. Finding the task in such good hands," says Mr. Gibson, "I gladly made over to him all the information which had come within my reach, and during the few latter years of his (Forster's) life we had frequent conversation and correspondence on the subject of his intended Flora. After his death, in 1849, no manuscript of this description was found among his papers, and therefore I was induced to resume the undertaking, for which materials from various sources were gradually accumulated, till the appearance of the Floras of Suffolk and Cambridgeshire stimulated me to put them into shape for publication." Accordingly, in 1862, 'The Flora of Essex; or a List of the Flowering Plants and Ferns found in the County of Essex; with the Localities of the less common Species ascertained by recent observation and reference to former Authors, and Illustrated with four coloured Plates of the Plants peculiar to the County, and a Map'; small 8vo, pp. l. and 470, was published by William Pamplin, London. Issued at six shillings, which can hardly have exceeded the bare cost of production, this work was a considerable expense to its author; but yielded him in return a well-merited scientific reputation as a local botanist. It was in several respects a distinct advance on preceding county floras. As had been done in the 'Flora Hertfordiensis' and 'Flora of Cambridgeshire,' he carefully traced the distribution in the county of common as well as of rarer plants; but he also searched and incorporated the work not only of Ray, but of most of his predecessors: he gave a table of the earliest and latest known observations of the less common species, and one comparing the flora of Essex with those of Suffolk, Cambridge, Hertford, and Kent; and he affixed biographies of four of his chief predecessors in Essex botany, Ray, Dale, Warner, and Forster, which are alike accurate and concise. The only great improvement in county floras established since the publication of this work has been the substitution of the division into river-basins for that into artificial districts.

In 1845 Mr. Gibson married Elizabeth, daughter of Samuel Tuke, Esq., of York, and sister to the well-known physician. In 1847 he became a Fellow of the Linnean Society; but, after the publication of his Flora and the death of his father, other duties took him away from active scientific work. He nevertheless evinced to the last his deep sympathy with the multiform progress of knowledge. He was a skilful photographer, and took great interest in the progress of electric lighting; and among his many services to his native town was the promotion of the branch railway from Audley End. His father having, in 1830, discovered a number of human skeletons in his garden, Mr. Gibson in 1876 commenced a series of excavations which have resulted in the discovery of about 150 skeletons with ornaments belonging mainly to the 9th or 10th century, underlaid by a prehistoric village of pit-dwellings, with bones of Red Deer, *Bos primigenius*, and other early mammals, and implements of bronze and iron. These most important discoveries will be described in an interesting paper by Mr. H. Ecroyd Smith, illustrated, at Mr. Gibson's expense, by twelve valuable plates, in the forthcoming part of the 'Transactions of the Essex Archæological Society.'[2] Besides a good herbarium, including that of Lightfoot, he possessed an admirable collection of fossil shells from the Crag.

He became a member of this Club on May 28th, 1881. He was present at the York Meeting of the British Association, and among the last works of his life was the re-arrangement of the Saffron Walden Museum, mainly founded by his uncle, Jabez Gibson, about 1834. This work was begun in 1880, before which time the state of the collections was almost indescribable; and it has been carried out most completely at great expense, many valuable series of specimens having been presented by Mr. Gibson, or, like the series of antiques from Cyprus, procured through his instrumentality. He had hoped to have received this Club at Walden on the occasion of the re-opening of this Museum.

In 1877 and 1878 he held the office of Mayor of Walden,

[2] [Since published, Trans. Essex Arch. Soc., vol. ii. (N.S.), p. 311.—Ed.]

and at the time of his death he was an alderman and J.P. for the borough, and senior partner of the firm of Gibson, Tuke, and Gibson,[3] whose banking-house is one of the chief ornaments of the Market Square, where also stands a handsome fountain erected by Mr. Gibson in commemoration of the Prince of Wales's marriage. He built a new Town Hall and several almshouses in the town; further endowed the Hospital founded by his father; gave seven acres as a site for the Friends' School, of which he was Treasurer; and a site with the princely donation of £10,000 to the British and Foreign School Society's Training College. He was also a liberal contributor to the Free Grammar School and many other institutions, by no means exclusively those of the sect to which he belonged. For many years he had presided, as "Clerk of the Yearly Meeting," over the conferences of the Society of Friends, and the very last act of his life was in connection with this office; since, acting as president during a long discussion on 'The Book of Discipline,' he aggravated an internal disease of long standing, and died, after five weeks' illness, at the Devonshire House Hotel, Bishopsgate Street, London, on April 5th, of inflammation of the kidneys.

He was buried on the 11th in the pretty little burial-ground behind the Friends' Meeting House, in his native town, being followed to the grave by about five thousand people, testifying to the general respect for one of whom it has been said that "he does not seem to have left a single enemy."

Small of stature and with a face in which several persons have been struck by a resemblance to Mr. Herbert Spencer, he was quiet and unobtrusive in manner. Seldom speaking until he had formed a matured opinion, he was an unusually "well-read" man, of wide culture and of sound judgment. Exact, punctual, cautious, and conscientious in an unusual degree, he was alike fitted to succeed in business or in scientific investigation. It has been written of him by those

[3] He was thus one of the remarkable number of botanists for whom we are indebted to the banking profession, among whom have been Dawson Turner, Edward Forster, and the present President of the Linnean Society, the two last members of one firm.

who knew him personally that "the blending of intellectual and moral qualities made him what he was. He grudged no amount of costly or toilsome research to verify a fact or arrive at the true understanding of anything with which he had to deal. Few men of equal wealth can ever have taken as much pains to dispose of it rightfully, and the extent of his private charities will never be known. Plain-spoken, he was yet considerate for the feelings of others, and would interest himself in their behalf as completely as in his own affairs. So punctual was he in keeping engagements that at a meeting at which he chanced to be two minutes late it was concluded that he had been altogether prevented from attending."

As a botanist Mr. Gibson must undoubtedly take high rank among the pioneers of the critical study of British forms. He possessed a fine library of botanical as well as of other works. It may be doubted whether he had much of that knowledge of continental species that distinguishes his friend the Professor of Botany at Cambridge, but his knowledge of our own Flora was amply sufficient to enable him to recognise a new form as such, when he, with characteristic modesty, submitted his discoveries to the judgment of Professor Babington and others. Everyone who has followed in his steps in the study of our older botanical writers will fully endorse his remark that "the examination of these old works has produced a decided conviction that much care was exercised by" them, "both as regards descriptions and localities, and that they may generally be relied on"; but of the cautious and scrupulous accuracy, the completeness and acuteness of his own work as seen both in the Flora and in his separate papers, one may speak with unreserved praise.

John Eliot Howard was born at Plaistow, December 11th, 1807. His father, Luke Howard, the great-grandson of an officer who lost his fortune and estate in the cause of James II., was towards the end of the last century a partner with Mr. Allen in the Pharmacy at Plough Court, and subsequently founded the well-known firm of chemical manufacturers, Howards and Sons, of Stratford. He is better known, however, as a meteorologist, especially for his system

of nomenclature and classification of clouds proposed in 1802 and still in general use. He was a Fellow of the Royal Society, and a correspondent of the poet Goethe, who wrote a poem upon him. His wife was descended from the Westons, Earls of Portland.

JOHN ELIOT HOWARD, F.R.S.[4]

After leaving school, Mr. J. E. Howard joined his father in the business at Stratford, with which he remained in connection until his death.[5] He joined the Pharmaceutical Society in 1853, not being, as has been stated, one of the

[4] [For this portrait we are indebted to the kindness of the Editor of the 'Graphic.' It is engraved from a photograph by Messrs. Maull & Co. —Ed.]

[5] His first paper was published in 1852, and was very characteristic of much of his work, being a lengthy and exhaustive report on the Collection of Cinchona in the British Museum made by the Spanish botanist, Pavon.

founders of that Society, and in 1857 he was elected a Fellow of the Linnean Society. His researches in connection with febrifuge alkaloids led him, when at Madrid in 1858, to purchase the manuscript of the 'Nueva Quinologia' of Pavon and a large collection of specimens of Cinchona made by that botanist in Peru. He also employed Mr. Fitch, the well-known botanical artist, to proceed to Madrid to make drawings from Pavon's specimens. The result was the publication, in 1862, of Mr. Howard's magnificent illustrated work, 'Illustrations of the "Nueva Quinologia" of Pavon, and Observations on the Barks Described.'

When the Government of India, with the help of Messrs. Clements Markham, Spruce, and Cross, introduced cinchona cultivation into that country, they found Mr. Howard ready to give them all the advice and assistance in his power without a thought of recompense. He undertook analyses of all the varieties of Peruvian bark grown in India, drew up a series of reports invaluable to cultivators, and embodied the results of his investigations in another costly work, the 'Quinology of the East Indian Plantations,' published in 1869. He received the thanks of Her Majesty's Government for his services from the Duke of Argyll, then Secretary of State for India, in 1873, and in 1874 was elected a Fellow of the Royal Society. In October, 1883, Mr. Howard received the Hanbury Gold Medal of the Pharmaceutical Society in recognition of the value of his researches respecting materia medica. A descriptive botanist and an analytical chemist rather than a philosophising naturalist, Mr. Howard became a Vice-President of the Victoria Institute, and published various papers in the Journal of that Society on the reconciliation of Science and Revelation. He also took considerable interest in gardening, especially in hybridisation as bearing on Cinchonas, of which he had a large number in cultivation. He was a member of numerous continental scientific societies, and the author of numerous papers, mostly on Quinology.

He married Maria, daughter of the late W. D. Crewdson, of Kendal, and leaves a large number of children and grand-

children. His death followed a very short illness, occurring at his house, Lord's Mead, Tottenham, on November 22nd, in his seventy-sixth year. He was buried on the 28th, in Tottenham Cemetery, in the presence of a large number of relatives, friends, and representatives of the scientific societies to which he belonged.

Mr. Howard always evinced considerable interest in this Club, of which he was an original member, occasionally driving over to our Field Meetings from Tottenham. Though we may hope that the advance of synthetic chemistry may some day render us no longer dependent, for our supplies of that invaluable medicine Quinine, upon the precarious cultivation of a single genus, yet the life-work of John Eliot Howard in the service of pharmaceutical science, and thus in the cause of humanity, is likely to be long and gratefully remembered.

When the year opened, the Forest in which our Club is so deeply interested was threatened with the encroachment of a railway; but this scheme, which was supported by the Corporation who should have been the protectors of the Forest, was, I need hardly remind you, happily defeated, in a great measure through the action of the Club. During the contest we were given to understand that, if successful, we should meet with abundant aid from the outside public in defraying the necessary expenses of printing and postage incurred; but I am sorry to say that this has not to any considerable extent been the case, so that nearly £30 from the funds of the Club has had to be devoted to this purpose. This has contributed to prevent the issue to members of more than one Part of our 'Transactions' during the year; but this is also largely due to the considerable number of subscriptions for 1883, and even for 1882, which have not yet been paid.

I am sorry to feel obliged to speak as to the thoughtlessness, not to say dishonourableness, of thus crippling the resources of the Club. Thanks, however, to the generosity of friends who have given us illustrations, I do not think we have any occasion to be ashamed of Part 7 of our 'Transactions,' the editing of which, a laborious though unnoticed

task, certainly reflects great credit upon our Secretary. Nevertheless I must call your attention to the fact that we are already seriously in arrear in the printing both of Papers and of Proceedings, and that this is a difficulty that will surely increase rapidly in the future, unless a special effort is made to overtake it.

The ordinary work of our meetings, both here and in the field, has gone on much as usual; we have heard many papers and discussions of interest, and have had large attendances at several very pleasant rambles; but I hope during the present year that our Secretaries may be kindly relieved of some of the work connected with the organization of field meetings by local residents, who will, I hope, volunteer their services as directors.

Perhaps one of the most satisfactory proofs of our vitality is the many new lines of research that we feel constrained to take upon ourselves. Having followed up our investigation of Ambresbury Banks by that of the Loughton Camp, we have now undertaken the exploration of the mysterious Deneholes of the county; and, endeavouring to carry out that supreme object of local societies, the cataloguing of local objects, at the suggestion of my eminent predecessor Mr. Meldola, who I may say has worked as hard for us, as a Vice-President, as he did when President, we have also undertaken a catalogue of all the Prehistoric remains in the county.

In concluding this introductory portion of my Address, I wish to take the opportunity of making an appeal of a somewhat personal character. With the kind consent of Mrs. Gibson, I propose at once to take in hand the preparation of a new edition of the 'Flora of Essex,' and I hope that all of you who can will kindly afford me your aid in the work by communicating to me suggestions, notes, lists or specimens. I propose to present all the type-specimens to the Club herbarium.

For the special subject of my address this evening I have chosen a subject related, on the one hand, to those researches into the earliest history of man in Britain that are, I believe, of interest to many of us, and on the other to the science of Botany, my own chief line of study. This is—

The Influence of Man upon the Flora of Essex.

It may be doubted whether the whole of England has ever been simultaneously submerged since the Chalk period, if it were so even then. The great elevation, however, which seems to have marked the earlier part of the Glacial Epoch, followed as it was by a depression perhaps more than a thousand feet below existing levels, probably cut off the history of the flora represented by the pines and alders of the Cromer forest-bed and the Arctic Willow and Dwarf Birch of the Bovey-Tracey clay, or at most left as its only representatives those alpine species of North Wales with which we in Essex are not immediately concerned. The second continental period in that epoch is, therefore, probably that during which the bulk of our British flora migrated from what we may term its Germanic mainland, from the chalky uplands of the Ardennes, from the palæozoic rocks of Belgium, from the alluvial plains of Lower Rhineland, from the forests of the Hartz and of Denmark. It is no part of my present purpose to attempt to determine the first appearance of man upon the scene.

The savage known to science as Palæolithic man, the contemporary of our great extinct Thames Valley fauna, seems to have been wholly ignorant of agriculture, and may even have been entirely pre-glacial and have roamed through forests of the no-longer indigenous Scotch and Spruce Firs. It is with the far more modern Mongolian Neolith that we are now first concerned—the comparatively cultured race who came perhaps not more than ten or twelve thousand years ago from their lake-dwellings in Switzerland [6] and from

[6] See Elton, 'Origins of English History,' pp. 134—137, a most valuable work, from which I have gathered much information here utilised. Lyell, 'Antiquity of Man,' ed. i., p. 31; Figuier, 'Primitive Man,' p. 231; Herodotus, lib. v., cap. 16:—"ἐπειρήθη δὲ καὶ τούς ἐν τῇ λίμνῃ ἐξαιρέειν, ὧδε κατοικημένους· ἰκρία ἐπὶ σταυρῶν ὑψηλῶν ἐζευγμένα ἐν μέσῃ ἕστηκε τῇ λίμνῃ, ἔσοδον ἐκ τῆς ἠπείρου στεινὴν ἔχοντα μιῇ γεφύρῃ. . . . . οἰκεῦσι δὲ τοιοῦτον τρόπον, κρατέων ἕκαστος ἐπὶ τῶν ἰκρίων καλύβης τε ἐν ᾗ διαιτᾶται, καὶ θύρης καταπακτῆς διὰ τῶν ἰκρίων κάτω φερούσης ἐς τὴν λίμνην." Cameron, 'Across Africa,' on huts on Lake Mohrya; and Keller's 'Lake-Dwellings,' translated by J. E. Lee.

the peaty pine forests of Denmark, bringing with them cows, sheep, pigs and goats, wheat, barley, flax and perhaps pulse, and even fruit trees.[7] Our first enquiry must be what was the state of vegetation in Essex at this commencement of agriculture. We may take it that, drainage, fen reclamation and tillage excepted, the surface soils of our county were then as they are now, *i. e.* (with the exception of two small areas of Chalk down, in the south and in the north-west) clays of Eocene or Glacial age, stiff loams or gravels, having an undulating surface, but only a slight general slope, covered the whole area, abounding in marsh and streams and surrounded on two sides by the gravels and peats of the Thames flats, then probably frequently inundated, and by the muddy levels of our eastern coast, which has probably altered much in outline and but little in vegetation.

The astronomical causes that produced the Glacial Epoch were no longer in operation; but the climate may then have been slightly colder than now, and the rainfall was in all probability greater, as evidenced to some extent by the more general and more rapid growth of peat. Undoubtedly, from that day to this, man by clearing forest, by draining land, and by embanking rivers and the sea, has exerted a most important influence upon both the moisture in the air and that in the soil.[8]

[7] See Greenwell and Rolleston, 'British Barrows.'

[8] "It is certain that the island when it fell under the Roman power was little better in most places than a cold and watery desert. According to all the accounts of the early travellers, the sky was stormy and obscured by continual rain, the air chilly even in summer, and the sun during the finest weather had little power to disperse the steaming mists. The trees gathered and condensed the rain; the crops grew rankly, but ripened slowly, for the ground and the atmosphere were alike overloaded with moisture." Elton, *op. cit.*, p. 223. "In Mauritius, once the sanatorium of India, the climate has undoubtedly deteriorated, as the air has become drier from the removal of the forests, and the springs are drying up. . . . . Humboldt mentions that the water supply of Venezuela had decreased, from the clearing of some of the forests; whilst some of the West Indian Islands, in spite of a tropical rainfall, have been reduced to arid sandy wastes. South Africa has suffered much in climate from the destruction of forests, the rainfall having become somewhat less and very irregular."—"The Science and Teaching of Forestry," 'Journal of Forestry,' vol. vi.

The thin layer of clay and flints, covered with grass and dotted with Juniper, Clematis, the Rock Meadow-Rue (*Thalictrum saxatile*), the Pasque-flower (*Anemone pulsatilla*), and other characteristic plants, that overlies the Chalk, has probably never within the period under consideration been more wooded than it is at present. With this exception and that of the maritime flats saturated with brackish water and exposed to the sea-breeze, the whole country was on the arrival of man almost certainly one unbroken virgin forest. [9] This forest indeed, may even have extended to the very banks of the Thames, the Lea, the Blackwater, and the Stour, those rivers, as we gather alike from the submerged forest from Plumstead to Grays, and from the Deneholes of Purfleet, running perhaps at relatively lower levels, *i. e.*, the country not having as yet sunk to its existing elevation. At the commencement of history, however, before existing embankments, there is no doubt that the lowlands of the valleys and estuaries of the rivers I have named were tidal flats, destitute of vegetation, or producing only the Aster, Sea Lavender, Thrift, Sea Plantains and Asparagus of our eastern coasts. [10] Man has but slightly affected our maritime flora, whilst those of inland swamps and fresh-water have been diminished perhaps by his drainage operations ; but have been but slightly added to through his agency.

The trees of this primeval Essex forest were the Oak,[11]

[9] See "The President's Inaugural Address," by Raphael Meldola, F.R.A,S., F.C.S., &c., Trans. Essex Field Club, vol. i., p. 8.

[10] "Whatever may be the date of the mighty embankments which have given its present form to the river channel, there can be no doubt that they did not exist in the time of Claudius. Those vast tracts known as the Isle of Dogs, the Greenwich Marshes, the West Ham and Plumstead Marshes, &c. (which are now about eight feet lower than high-water), were then extensive slobs covered with water at every tide. The water below London was then an enormous estuary, extending from the hills or hard sloping banks of Middlesex and Essex to those of Surrey and Kent, with one head towards the valley of the Thames, and another head towards the valley of the Lea."—Sir George Airy, 'Athenæum,' No. 1683 (1859.)

[11] The Oak can be traced from the oldest post-glacial submerged forests, and from Irish peat-bogs contemporary with the *Megaceros*, through the times of Druidism to the age when our place-names mainly

Yew,[12] Holly,[13] Hazel,[14] Hornbeam,[15] Birch, Ash, Hawthorn, Alder, Willows, Aspen, Spindle-tree, Cornel, Buckthorn, Elder, Wych Elm (*Ulmus montana*), Guelder Roses, Maple, Apple, Mountain Ash, Sloe, Bullace, and, I believe, the Beech and the Wild Cherries. I am more doubtful as to whether it contained a Linden or a Common Elm (*Ulmus campestris*, With.), and still more so as to the presence of the Privet. The last tree appears indigenous in the south of Ireland, and perhaps on the Sussex Downs, but hardly in Essex. The Elm is confined to the south of England, and may have been introduced with the Vine by the Romans. It is a hedgerow rather than a forest tree, though no conclusion can be drawn from its not often ripening seed in England, as this is

originated. It must probably have spread to Ireland through England. See "On the Origin and Distribution of the British Flora," Trans. Essex F. Club, vol. ii., p. 75, and DeCandolle, 'Géographie Botanique,' p. 1064.

[12] The Yew is found in Irish peat-bogs, and existing trees may be more than 2000 years old. "The remains of many ligneous plants have been found at the bottom of the peat, rooted in the clay upon which they grew, such as the Hazel. . . . . Dugdale states that Oak and Fir trees have been found with their roots in the firm earth below the peat; and that in Marshland, a part of the Fen lying between Wisbech and the sea, Furze-bushes and Nut-trees rooted in the solid earth were met with at sixteen feet below the present surface. Indeed there can be no doubt that the trees, Fir, Oak, Yew, &c., really grew on the soil which is now deeply buried."—Professor Babington, 'Flora of Cambridgeshire,' p. xvi.

[13] Ancient Holly trees form the oldest part of the Forest of Dean, round the Speech-house, and oaths in the Forest courts were sworn on Holly-branches. The tree in Aubrey's time formed the greater part of the Forest of Kingswood, north of Bristol, and it has been noted as associated with ancient earthworks on bleak Cornish hills. I have traced it in an apparently indigenous condition, through the old Forest of Anderida, and certainly its dense growth in Henhault, Theydon Garnon and Epping Forests has every appearance of being indigenous.

[14] Hazel-nuts occur commonly in the submerged forests. Hazel rods have long been used for divining, aud were buried with Benedictine monks.

[15] The Hornbeam I have traced under conditions having every appearance of being indigenous through Sussex and Surrey. It "formed a large, perhaps the chief part of the ancient forest on the clay north of London, of which Enfield Chase was the remains" (Trimen & Dyer, 'Flora of Middlesex'), as also at Easeneye Park, Ware.

a character of the species everywhere. Neither the Elm nor the Beech is known in submerged forests, or in pre-historic works in wood.[16] DeCandolle suggests[17] that the Latin name *Tilia* for the Lime is derived from the Celtic, and, since I doubt whether the Neolithic Mongols, the Finns of the Bronze Age, or the Celts are likely to have introduced exotic trees, this would make the Small-leaved Linden indigenous.[18] The Romans in all probability introduced the cultivated Cherry, the English name of which is but a corruption from the Latin;[19] but it is none the less probable that one or more of the wild species may have been indigenous. The argument as to the Beech is similar to that with reference to the Lime. The tree has every appearance of being as wild as the Oak or the Hazel; its Latin name *Fagus* may very probably be of Celtic origin,[20] Cæsar's assertion that it does not grow in England[21] may refer to the Chestnut, or may be otherwise explained. Our Secretary proposes to undertake the microscopical examination of the charcoal found in the pre-Roman camp at Loughton, a research of a difficulty only surpassed by its interest; for no doubt the wood of Beech and of Hornbeam will prove very similar when charred. I believe the Alder to have been much reduced in quantity by

[16] Professor J. Phillips, 'Geology of Oxford and the Valley of the Thames,' p. 52. I certainly think the Professor under-estimates the antiquity of the Elm in saying that it can only "be traced back three centuries."

[17] 'Géographie Botanique,' p. 659.

[18] The Kentish name "Lyndhurst" is at least as old as the tenth century.—Pearson, 'Historical Maps,' p. 54.

[19] "Cerasus, ciris beam, cherry."—Professor J. Earle, 'English Plant Names from the Tenth to the Fifteenth Century,' p. 1.

[20] "Toutes les langues du midi de l'Europe ont, pour cet arbre, des noms dérivés du *Fagus* des Latins . . . ; de plus, par le changement si fréquent de *f* en *h*, *Haya* en espagnol, *Hatsch* dans le patois de Saint Girons, ... *Hestre*, et maintenant *Hêtre* en français. . . . . les Grecs appelaient le *Fagus sylvatica* Οξυα et non Φηγος . . . . A mon avis, le mot *Fagus* doit prendre sa source dans les langues celtiques, antérieures au latin."—DeCandolle, *op. cit.*, p. 689.

[21] Cæsar, 'De Bello Gallico,' lib. v., cap. 12, "Materia cujusque generis ut in Gallia est, præter fagum atque abietem." "Cela peut signifier que le

drainage, and both the Holly and the Yew to have been also more abundant than at present, though I do not know of any confirmation of the statement, in Mr. Palin's 'Stifford and its Neighbourhood,' that the submerged forests at Grays consist largely of Yew and Elm.[22] The thickest parts of Epping Forest a few years back gave some idea of the denseness of the underwood in a primæval forest; but, even there, such evergreens as the Butcher's Broom,[23] the Lesser Periwinkle (*Vinca minor*), and the early-flowering *Daphne laureola* and *mezereum*[24] could live, whilst Primulas, Orchis,

Hêtre n'était pas assez commun pour donner des bois de construction, ou qu'il ne s'était pas rencontré sur le chemin des armées romaines."—DeCandolle, *loc. cit.* Professor Rolleston suggested that "præter" may here mean "besides," and not "except."—Journ. Roy. Geogr. Soc., vol. xlix., p. 320.

[22] *Op. cit.*, p. 41, on the authority of the late Richard Meeson, F.S.A., F.G.S., who writes: "The submerged forests of the Thames in Grays are also worthy of notice. There are here three; the upper one consists almost entirely of yew-timber and brushwood, about three feet thick; then three feet of river mud; and then another forest about the same thickness, principally yew; then three feet more mud; and then the lowest, containing, besides the yew, large trees of elm and oak." On p. 81 occurs the following further reference to "the subterranean forest discovered in making the railway skirting the river to Barking. This moor-log, or vein of buried wood, lies three or four feet under the surface, and is about ten feet in depth. It contains yew trees fourteen or sixteen inches in diameter, and perfectly sound; willows more than two feet in girth, but like touchwood; and mingled with it is small brushwood, and even hazel-nuts, which appear sound to the eye but crumble to the touch. Some have indulged learned surmises that these are the remains of the devastation of the Deluge; others, that they are the remnants of the old forest, beaten down and buried by storms and inundations at a later age; but the most practical conclusion is, that they were purposely laid there by some of the rude engineers of olden times, as foundations for works to shut out the troublesome flow of the Thames."

[23] *Ruscus aculeatus*, the Cneoholen, or Knee Holly, still abundant in Epping Forest, happens to be the first Essex plant recorded by William Turner, "the father of English Botany," in his 'Herball' (1551), who says of it, "This bushe groweth verye plenteously in Essex". . . . .

[24] *Daphne mezereum*, L. "M. Watson, malgré l'assertion de plusieurs botanistes, qui disent l'espèce bien spontanée et qui la croient native, pense qu'elle est d'origine étrangère. Il convient, toutefois, que la distribution géographique sur le continent est contraire à cette idée.

Blue-bells (*Scilla nutans*), Herb Paris (*Paris quadrifolia*), Garlic (*Allium ursinum*), Wood Anemones (*Anemone nemorosa*), Violets (*Viola sylvatica*), Woodruff (*Asperula odorata*), and Kingcups (*Ranunculus ficaria*), would manage to live and flower under the deciduous parts, or where some monarch of the glen had succumbed to age or tempest. Such shade-lovers as Solomon's-seal (*Polygonatum multiflorum*), Enchanter's Nightshade (*Circæa lutetiana*), the Wood-sorrel (*Oxalis acetosella*), or the Burdocks would flourish, Ivy and Sanicle may have been as abundant as now, and the Green Hellebore still more so; whilst Honeysuckle (*Lonicera periclymenum*) and the Bryonies (*Tamus* and *Bryonia*) would scramble towards the light. Brambles (*Rubi*), Canterbury-bells (*Campanula trachelium*), Golden-rod (*Solidago virgaurea*) and Betony (*Stachys betonica*) will flower under a tolerably thick shade; but even in a forest untouched by human hand there must have been various open spaces, the close-turfed, thin-soiled down, the natural heath, the spot trodden down and manured by the herd of forest animals, or the swamp. As I have already said, the area of down, for such plants as Clematis, Quinsy-wort (*Asperula cynanchica*), Centaury (*Erythræa*), Gentian (*Gentiana amarella*), Dropwort (*Spiræa filipendula*), Wild Thyme, Bugloss (*Echium*), Perfoliate Yellow-wort (*Chlora*), Rest-harrow (*Ononis*), Milkwort (*Polygala*), Mignonettes (*Reseda*), Barberry (*Berberis*), Vervain (*Verbena*), Juniper, the Clustered Bell-flower (*Campanula glomerata*), the Pasque-flower (*Anemone pulsatilla*), *Saxifraga tridactylites* and our rarer Orchids, in our county must have been small; but probably such flowering plants as these were better able to contend against the spreading growth of the social grasses when the downs were not kept closely nibbled down by flocks of sheep, or the still more destructive goats.

It would be just on the edge of the forest, where it abutted upon down or heath, that such plants as the vetches,

Bromfield l'a combattu dans le 'Phytologist' (1830, p. 796). . . . . Le Mezereum est indiqué comme rare, ou assez rare, mais spontané dans les bois en Normandie. . . . . Je ne voit pas pourquoi il n'en aurait pas été de même primitivement en Angleterre."—DeCandolle, *op. cit.*, p. 684.

Agrimony (*Agrimonia eupatoria*), Columbine (*Aquilegia*), *Helleborus fœtidus*, Hound's-tongue (*Cynoglossum*), Deadly Nightshade (*Atropa*), *Iris fœtidissima*, Cow-wheats (*Melampyrum pratense* and *M. cristatum*), Wood-sage (*Teucrium scorodonia*) and Roses, plants that require sun, would then find a lodgment, together with some such as Golden-rod, Betony, and others, which I have already mentioned. The Foxglove (*Digitalis*) is in flower when some leaves have already fallen, and flourishes under dense heath or bracken, or even under trees. Of the plants I have mentioned nearly all are undoubtedly indigenous, and a study of the growth of the Lesser Periwinkle in ancient woodlands in Essex and in Sussex, and of that of the Iris on broken ground in the south-east of Kent, has strongly impressed me with the native character of what are perhaps the most doubtful in my list. On elevated gravelly plateaux more especially, the heaths, when they have gained possession of the ground through a storm, or in human times through a clearing or a forest fire, will hold their own apparently against most of our forest trees, except perhaps the Birch. Capable, like the plants that accompany them, of living in very shallow and poor soil, mere sand, or pebbles, such as the lighter beds of the Bagshot series, the Heaths must, from the first, have formed open tracts, the grazing lands of herds of wild deer and cattle. Here they were accompanied by Bracken, Raspberries (*Rubus idæus*), Broom (*Sarothamnus*), the Genistas (*G. anglica* and *G. tinctoria*), St. John's-worts (*Hypericum*), Harebells (*Campanula rotundifolia*), Potentillas, Bedstraws (*Galium*), Scabious, and, I believe, three species of *Ulex* or Gorse. The late flowering of *Ulex europæus*, though perhaps an argument for its foreign origin in a remote past, is, since it ripens seed abundantly, no proof that it may not have spread to Britain without human aid.[25]

I have next to mention a class of localities often overlooked, the trodden-down, well-manured, resting-places of the forest herds, which are important as perhaps affording the only natural habitat for a large group of plants which afterwards

[25] See note on p. 16, *supra*.

occupied as weeds the manure and rubbish-heaps and waste ground of civilisation.[26] Such were probably the Mousetail (*Myosurus*), the Mustards (*Sinapis*), the Penny-cress (*Thlaspi arvense*), the Groundsels (*Senecio*), the Sow-thistles (*Sonchus*), the Black Nightshade (*Solanum nigrum*), and probably the Celandine (*Chelidonium*), the London Rocket (*Sisymbrium irio*), and the Stinging Nettles (*Urtica urens* and *U. dioica*). The only argument against the indigenous character of these plants is that after the appearance of man they have chosen to grow on the most richly manured land available to them, thus frequenting his waste-heaps and cottage hedgerows.

With a greater rainfall and no artificial drainage far more of the stiffer soils of Essex than at present must have been marsh or peat-bog.[27] The fall of a tree will dam a stream and originate a pool of stagnant water, which may become entirely blocked by *Sphagnum*, *Osmunda*, or Golden Saxifrage (*Chrysosplenium*). On the peat thus forming Marsh-marigolds (*Caltha*), Sundews (*Drosera*), Pennywort (*Hydrocotyle*), Whortleberries (*Vaccinium*), the Bog Pimpernel (*Anagallis tenella*), the Spotted Orchis (*Orchis maculata*), the Ivy-leaved Bellflower (*Wahlenbergia hederacea*), the Red-rattles (*Pedicu-*

[26] See DeCandolle, *op. cit.*, pp. 650, 652, sub *Chelidonium* and *Sisymbrium irio*.

[27] The following account of the Cambridgeshire Fen is suggestive with reference to some parts of Essex :—"As the character of the Fen district is very little known, it is well to remark that the peat is not formed of *Sphagnum*, like that of the bogs, but consists chiefly of the remains of various aquatic herbaceous plants. At the bottom there is a layer formed mostly of the remains of the woody plants and trees which constituted the forest which formerly covered the country. The remains of oak, yew, hazel, and willow are found abundantly in some parts of the Fens, and pine wood is plentiful in others. The wood of the larger trees is often well preserved and turned quite black, but a few inches of the surface have become soft and spongy. The latter is the condition of most of the smaller branches and the lesser ligneous plants. The Rev. Leonard Jenyns informs us that it is the opinion of the turf-cutters at Isleham that, before the present more perfect drainage of the Fen, the turf grew at the rate of about twenty inches in sixteen years. Now the want of sufficient water has put an end to this restoration of the turf in the places where it has been cut for fuel."—Professor Babington, 'Flora of Cambridgeshire,' p. xviii.

laris), the Marsh Cinquefoil (*Comarum*), and St. John's-wort (*Hypericum elodes*), the Grass of Parnassus (*Parnassia*), the Ragged Robin (*Lychnis flos-cuculi*), Mints, Ragwort (*Senecio aquaticus*), Fleabane (*Pulicaria dysenterica*), Willow-herbs (*Epilobium*), Loosestrifes (*Lysimachia vulgaris*, *L. nummularia*, and *L. nemorum*), Rushes and Sedges, would then have flourished far more than at present.

The aquatic plants I need not enumerate, seeing that with the exception of the American water-weed (*Elodea canadensis*), man does not seem to have added one to the list, though possibly, in clearing rivers for navigation, he may have exterminated some, such as the Pillwort (*Pilularia*) and Moonwort (*Botrychium*), two interesting forms among the higher Cryptogams, of which the former grew in Henhault Forest in Forster's time,[28] and the latter near Colchester in that of Gerard.[29]

One plant which now grows in meadows liable to floods I must mention, since my experience of it leads me to differ from the authority of DeCandolle,[30] *viz.*, the Fritillary, or Snake-lily (*Fritillaria meleagris*). Gibson records it[31] as in process of extermination at Bumpsted, being transplanted into gardens; but it is never mentioned as a native by our older botanists, it has no old English name, it is beyond its continental range, and is limited to a few river-valleys, down which it spreads readily. The only locality I know for the species in the valley of the Severn is represented only by the white variety, and this and kindredly suspicious circum-

[28] "In Hog-hill Pond on Henhault Forest." Edward Forster, MS. note in 'Botanist's Guide.'

[29] "Lunaria minor. Small Moonewoort. . . . It groweth also in the ruines of an olde bricke kill by Colchester, in the grounde of master George Sayer, called Miles ende."—'Herball' (1597), p. 329.

[30] *Op. cit.*, p. 693. "Je penche pour l'opinion du docteur Bromfield, qui ne voit pas de motifs suffisants pour nier la qualité indigène de cette plante. . . . . Elle manque à la Normandie . . . . aux environs de Paris . . . . aux îles de la Manche . . . . et à l'Irlande. Je ne puis rien dire pour Bretagne, mais on retrouve l'espèce dans la Loire-Inférieure. . . . . L'Angleterre serait l'extréme limite à l'ouest, et la plante y serait naturellement plus rare qu'ailleurs, comme toute espèce sur sa limite."

[31] 'Flora of Essex,' p. 316.

stances would lead me to attribute its origin to the mediæval garden. It may be doubted whether before the days of weirs and mill-dams any exact analogue of its favourite habitat existed, and no doubt the other denizens of those meadows which are now the glory of English landscape, the buttercups and daisies, must before the days of agriculture have been far less general.

Coming to the plants of the estuaries and the low cliffs from Harwich to Southend the changes during the human period have been mainly due to the natural encroachment of the sea, and probably the Marsh Mallow (*Althæa officinalis*), the Fennel,[32] the Sea-holly (*Eryngium*),[33] and the wild Cabbage (*Brassica oleracea*)[34] flourished there, then as now.

Besides the plants to which I have alluded, I may mention the Mulleins (*Verbascum thapsus* and *V. nigrum*), Scorpion-grasses (*Myosotis*) and Mallows (*Malva*) of our waste spots, our rare Essex Hare's-ear (*Bupleurum falcatum*), at Ongar, the Earth-nut (*Bunium flexuosum*), of which we read as the food of the Caledonians in the 3rd century A.D.,[35] the parasitic Mistletoe,[36] and perhaps the Soapwort (*Saponaria*) and the Gooseberry (*Grossularia*), as indigenous. The Soapwort

[32] "In the inland localities it has probably only escaped from cultivation, but appears truly indigenous on the cliffs at Southend, if not elsewhere along the Thames."—Gibson, 'Flora of Essex,' p. 138. "Me parait indigène en Angleterre, comme sur le continent voisin, malgré le doute de M. Watson ('Cybele Britannica,' vol. i., p. 447)."—DeCandolle, *op. cit.*, p. 667.

[33] "At Landamer lading, at Harwich, . . ." Gerard, 'Herball' (1597), p. 1000. "Colchester is noted for the first inventing or practising the candying or conditing of its roots, the manner whereof may be seen in Gerard's Herbal."—Ray, in Gibson's Camden's 'Britannia.'

[34] "Je ne vois pas pourquoi il n'aurait pas été spontané, avant l'homme, en quelques points de l'Angleterre, puisque sa patrie doit être, d'après divers indices linguistiques, l'Europe occidentale tempérée, et qu'on le trouve sur des falaises en Angleterre et en Irlande."—DeCandolle, *op. cit.*, p. 653.

[35] 'The Scottish Gaël,' by James Logan, vol. ii., p. 113. Dion Cassius, lib. lxxvi., cap. 12.

[36] "I never sawe more plentye of righte oke miscel, then Hugh Morgan shewed me in London. It was sente to hym oute of Essex: where as there is more plentye then in anye other place of Englande that I have ben in,"—Turner, 'Herbal' (1568), lib. ii., p. 165.

is, however, often merely a garden escape, having even double flowers; singularly indestructible and capable of spreading along the banks of a stream. It may, therefore, have come from the Saxon or Norman flower-garden. The Gooseberry has Celtic names of native origin, was not cultivated by the Romans, and bore the Anglo-Saxon name of "Fea-berry." It may, therefore, be indigenous,[37] though its existing localities seldom have that appearance.

Coming to such an Essex as this, the short swarthy Mongolian Neolith, with polished celt, gold ornaments, flocks and herds,[38] must, I think, without intentionally introducing new plants, have had an immense indirect influence upon our flora. He is not likely, when not harassed by an invading race, to have lived by choice only on those hills and downs on which he has left us the cromlechs and long barrows that probably belong to this age. Even if he preferred to live on pile-dwellings, as in Norfolk and in Holderness, he almost certainly effected a certain amount of forest clearing. Not to speak of artificial pasturage, he is believed to have grown flax, and here we have the necessity for tillage of a somewhat detailed character. In growing corn, flax, or other crops he must have unintentionally introduced weeds into the country, possibly the Pimpernel,[39] and that Plantain (*Plantago major*)

[37] DeCandolle, *op. cit.*, p. 911.

[38] "There are remains of domesticated forms introduced by the race which supplanted the Palæolithic tribes. These are the dog, horse, sheep, goat, short-horn, and hog. It is noteworthy that these domestic forms were not parts of the indigenous fauna of Europe. They appear at once in Neolithic deposits, leading to the inference that they were introduced by the human tribes which now migrated, probably from Central Asia, into the European continent. These tribes were likewise acquainted with agriculture, for several kinds of grain, as well as seeds of fruits, have been found in their lake-dwellings; and the deduction has been drawn from these remains that the plants must have been brought from Southern Europe or Asia. The arts of spinning, weaving, and pottery-making were also known to these people. Human skeletons and bones belonging to this age have been met with abundantly in barrows and peat-mosses, and indicate that Neolithic man was of small stature, with a long or oval skull."—Archibald Geikie, 'Text-book of Geology,' p. 907.

[39] The name is of Celtic origin, *pimper* signifying "five," in allusion to the petals.

which, following the European westward, is now known as "the White-man's foot" in North America. Ignorant as we are alike of the country whence he came, and of the language that he spoke, it is almost impossible to say what plants with Celtic names may not be of Neolithic origin. I can only suggest two, the Caraway,[40] (*Carum carui*), an Asiatic plant, not of Roman origin, having distinct names in all the languages of Northern Europe, and long established in England and known by more than one Welsh name; and the Woad,[41] (*Isatis tinctoria*), a native of Northern Asia, well known from its use in after times by the Celts for tattooing. It is possible that this custom may have been of Mongol origin in the west, as it has been apparently in the east. The plant does not appear to be indigenous; but is at least pre-Roman.

If we know little of the agriculture of the Neolithic Mongol, we appear to know still less of his successors, the tall Finnish race of the Bronze Age. They, too, had flocks and herds, they made both linen and woollen cloth, they lived in villages, and used iron for ornaments only.[42] Villages would probably

[40] DeCandolle, *op. cit.*, pp. 663-4. Its name is "Kummel" in German, "Kumina" in Finnish and "Cumin" in Swiss, "Carwass" and "Carddwy" in Welsh.

[41] "La culture en serait donc très ancienne. Les noms gallois, anglo-saxon, allemands, slaves, ont tous de l'analogie et font présumer un usage commun autrefois à toute l'Europe."—DeCandolle, *op. cit.*, p. 651. At a subsequent period the plant was much cultivated as a dye for cloth, as witness the following, referring to the year 1585:—"In the meantime a Proclamation was set forth to restrain the Covetousness of some private men in England who converted arable Lands and the richest Pasture-grounds to the sowing of the Herb Isatis commonly called Woad, for the use of Dyers, with great prejudice to cloathers and the countrey-men which fed on white-meats made of milk. Whereupon they were forbidden to sow that Herb within 8 miles of any of the Queen's Houses and within 4 miles of Cities, Market Towns and all other Towns where cloathing was used."—Camden, 'Annals of Queen Elizabeth,' ed. 4 (1688), p. 325.

[42] See Elton, *op. cit.*, p. 169, and the authorities there quoted, especially Herodian, iii., 14, and Dion Cassius, lxxvi., 12:—

> "Arma antiqua manus, ungues, dentesque fuerunt,
> Et lapides, et item silvarum fragmina rami,
> Et flammæ, atque ignes, postquam sunt cognita primum.
> Posterius ferri vis est ærisque reperta.
> Sed prius æris erat quam ferri cognitus usus."
>
> Lucretius, 'De rerum natura,' lib. i., 1282-6.

mean additional clearing of forest, and each new immigration may be presumed to have added to the density of the population, though it is believed not to have reached a a million by the time of Cæsar.[43]

It is with the fourth race, the Celts, that the written records of British History begin. Pytheas,[44] the astronomer of Marseilles, noted, in the middle of the fourth century before Christ, that they had abundance of wheat in Kent, which they thrashed in covered barns; that they drank metheglin, made of wheat and honey, and that they also grew millet, had cultivated fruits, and some domestic animals. Timeas,[45] a contemporary writer, mentions their canoes made of wicker-work covered with hide; whilst Posidonius, the Stoic, writing in the first century A.D., says "the people have mean habitations constructed for the most part of rushes or sticks, and their harvest consists in cutting off the ears of corn and storing them in pits underground." These "mean habitatations" seem to have been the bee-hive huts, whether subterranean, as at Salisbury,[46] or with a hollowed floor and wigwam-roof, as apparently on the Cotteswold Hills. They seem also to have erected stockades, "duns" or towns,[47] in times of war, and to have made no contemptible advances in agriculture and manufactures before the Roman invasion. They manured and marled their land, chalk being dug not only for home use, but for exportation to the Continent.[48] Cæsar gives somewhat contradictory accounts as to their corn, but certainly at a but slightly later period considerable

[43] Pearson, 'Historical Maps,' p. viii.

[44] For a full account of Pytheas, see the early part of Mr. Elton's work. His account of Britain is given on p. 32. The remains of his works have been collected in 'Pytheæ Massiliensis Fragmenta' by A. Arvedson, Upsala, 1824.

[45] See Elton, p. 35.

[46] See Stevens, 'Flint-Chips.'

[47] "Oppidum autem Britanni vocant, cum silvas impeditas vallo atque fossa munierunt, quo incursionis hostium vitandæ causa convenire consuerunt." — Cæsar, 'De Bello Gallico,' v., 21. Such a town was the "dun," the Welsh "dinas," a castle or a city.

[48] For a detailed account of this agricultural process and trade see Pliny, 'Historia Naturalis,' xvii., 4.

quantities of wheat and barley were exported by the Romans from Kent, and the Celts grew oats and rye also, besides flax and a considerable quantity of stock. Besides their celebrated willow baskets[49] they manufactured cloth, dyeing it black with the bark of the Alder, and flesh-coloured with that of the Willow.[50] Though this may refer to the Gauls of the Continent, they are also said to have sought to add to the terrific aspect of their bodies, tattooed with woad, by dyeing their hair and moustaches of a red colour, with a mixture of goats' fat and the ashes of Beech-wood.[51] Should this refer to Britain it has an unnoticed importance as bearing on the indigenous character of the Beech. The smelting of iron and silver belong apparently to late Celtic, but pre-Roman times. This would undoubtedly cause the more rapid clearing of forest, though perhaps the natural reproduction of timber would counterbalance not only the consumption for ordinary fuel, but also that for wrought iron in the early days of the manufacture.[52] This, however, concerns Sussex, and not our county.

[49] The word "basket" (Latin, "bascauda") is undoubtedly of Celtic origin, and "willow" possibly so. "Other plant-names may be added which are probably British, as *willow*. This may well be traced to the Welsh *helig* as its nearer relative, without interfering with the more distant claims of *saugh*, *sallow*, *salix*. *Whin*, also, and *furze* have perhaps a right here. And *eglantine*, which has become the standard poetic name for the dog-rose, and which has such a French air, due to its having been adopted from the poetry of the Fabliaux, is very probably a British word. With strong probability also may we add to this botanical list the terms *husk*, *haw;* and more particularly *cod*. . . . In Anglo-Saxon times it meant a bag, a purse or wallet. . . Thence it was applied to the seed-bags of plants, as *pease-cod*. This seems to be the Welsh *cwd*. The puff-ball is in Welsh *cwd-y-mwg*, a bag of smoke."—Earle, 'Philology of the English Tongue,' p. 21.

[50] James Logan, 'The Scottish Gaël,' vol. i., chap. vi.

[51] "Prodest et sapo, Galliarum hoc inventum rutilandis capillis: fit ex sebo et cinere. Optimus fagino et caprino."—Pliny, Hist. Nat., xxviii., 51. (The reference in Mr. Elton's work is incorrect).

[52] "The drain upon the woodland would necessarily be less in the earlier times, when iron was got direct from the ore in the malleable state, than when blast furnaces were introduced, and *cast* iron was first got, to be afterwards converted into malleable iron. . . . . The exact

Every schoolboy knows the traditions connected with the Druidical nature-worship, the sacred mistletoe on the sacred oak, and on the surrounding groves of only less sacred apple trees. I believe the apple to have been in cultivation ages before Ælfred took refuge in the marsh-surrounded so-called "island" of Avalon, or apples. There was no doubt a certain community of superstition among all the Aryan nations. For instance, Taranis or Etirun was the British form of the Scandinavian Thor, the thunderer, and the worship of oak, ash, hawthorn, and houseleek as sacred to him probably dates from Celtic, and not merely from early English, times. The Houseleek is not apparently wild anywhere nearer than the valley of the Loire, though grown much as with us in the North of France. The plant has several Celtic names, quite unlike those used by the English,[53] and whilst in Druidical times there may well have been communication with France, this is perhaps less likely during the pagan period of the English conquest.

We must not forget that between the paganism of pre-Roman Celtic Britain and that of Hengist and Ercemvine five centuries elapsed, during four of which the country was under a government which, if mainly military, cannot have existed, as it did, throughout the length and breadth of the land without great influence upon the natural condition of the country. An ear of Essex barley figures on the gold coin of Cunobelin, or Cymbeline, of Camulodunum,[54] before the

date of this change is unknown. . . . . The great drain upon the woodlands, which charcoal furnaces entailed, led to legislative action for their protection so early as 1543."—Topley, 'Geology of the Weald,' pp. 332-3.

[53] "Son introduction, en Angleterre, doit remonter à une époque très ancienne, puisque les Gallois d l'île d'Anglesea lui donnent quatre noms d'apparence celtique, du moins très différents des noms saxons et latins, et auxquels je ne trouve d'analogie éloignée que dans les langues slaves, par exemple, *Dislog* (gallois), et *Tschesnok dikoy* (russe). Dans cette dernière langue, *dikoy* signifie sauvage; mais le mot *Tschesnok* est un nom propre."—DeCandolle, *op. cit.*, p. 662.

[54] These coins, one of which is figured, among other places, in 'The Students' Hume,' p. 8, have been found at Colchester, Debden, Chesterford, Sandy (Bedfordshire), and Cambridge.—Akerman, 'Archæologia,' xxxiii.

arrival of the Roman emperor Claudius at that city, when the large tribe of the Trinobantes cultivated the cleared land between the then still broad and unembanked estuaries of the Stour, the Lea, and the Thames.[55] Whatever they may have been before, under the Roman military occupancy, the Britons became dwellers in towns. The Roman legionaries, with the assistance, no doubt, of native labour, drained fens, made paved causeways over morasses,[56] embanked rivers, and cut high roads through primæval forests; but in all probability in the latter operation they made as many morasses in the woodlands as they drained in the open country, the

[55] I am inclined to doubt if the Trinobantes held any territory west of so natural a boundary as the Lea. Their border settlement may have been Durolitum (Leyton ?).

[56] "It was a land of uncleared forests, with a climate as yet not mitigated by the organised labours of mankind. The province in course of time became a flourishing portion of the Empire; the court orators dilated on the wealth of 'Britannia Felix' and the heavy corn-fleets arriving from the granaries of the North: and they wondered at the pastures almost too deep and rich for the cattle, and hills covered with innumerable flocks of sheep 'with udders full of milk and backs weighed down with wool.' The picture was too brightly coloured, though drawn in the Golden Age. . . . . It is difficult to measure the slow advance of agriculture. We know that at one time the wolves swarmed in Sherwood and Arden, the wild boar roamed in Grovely, and the white-maned *Urus* was hunted in the northern forests. The work of reclaiming the wilderness began in the days of Agricola. The Romans felled the woods along the lines of their military roads; they embanked the rivers and threw causeways across the morasses, and the natives complained that their bodies and hands were worn out in draining the fens and extending the clearings in the forests. In the course of centuries the woodlands shrank to a mere fraction of their former extent. The ground was required for corn and pasture, the trees were consumed for fuel, or used in building or making the charcoal required in the mineral furnaces; and the hill-sides were kept bare as sheep-farming increased by the neglect to fence and protect the coppices. The area of cultivation was continually increasing; yet even under the later Plantagenets there were no less than sixty-eight royal forests, besides thirty which had been converted into private chases; in each was included 'a territory with great woods for the secret abode of wild beasts'; and it is estimated that even in the reign of Queen Elizabeth one-third of England was in waste."—Elton, *op. cit.*, pp. 222-4.

felled trees being probably often allowed to block up streamlets.[57]

Apart from this indirect influence upon our flora, it is to the Romans that we probably owe the first intentional introduction of new trees. To them we probably owe[58] the Chestnut, the Sycamore, the Box and the Laurel, together with the Walnut, Pear, Medlar, Quince, Damson, Peach, Cherry, Mulberry, Fig, and Vine, though it is impossible to say whether some of these introductions date from the Roman occupation or only from the missionaries of the fifth century. Thus Professor Earle, from a study of early English plant-names, says[59] "we seem led to the conclusion that the Saxon acquaintance with Roman botany must be dated as high as the Conversion, even if it be not the heritage of a provincial Roman culture." The Roman remains in our own county testify to the wide diffusion of general culture, art, manufactures, and luxury, under the Empire; whilst the works of Columella, Pliny, and Dioscorides, which belong to this period, tell us of the extent of the Roman knowledge of agriculture, botany, and medicine. Myself, I think it most probably to the period of occupation that we owe the trees I have mentioned, only one of which, the Pear, may, I think, have previously existed in the island, in a wild state. To this period belong also the Parsley, which has become a common garden escape during the last hundred years, the Opium Poppy, which they cultivated for its oil, the Turnip, the Rape, and the Cole-wort, besides a number of unintentional introductions of corn-field weeds. Growing a variety of crops in Italy and Gaul, and having perhaps

[57] "The felled wood was left to rot on the surface, small streams were choked up in the levels; pools formed in the hollows; the soil beneath, shut up from the light and air, became unfitted to produce its former vegetation; but a new order of plants, the thick water-mosses, began to spring up; one generation budded and decayed over the ruins of another, and what had been an overturned forest became, in the course of years, a deep morass."—Hugh Miller, 'Lectures on Geology.'

[58] Pliny, Hist. Nat., lib. xv., c. 25. Pearson, *op. cit.*, p. 54.

[59] 'English Plant Names from the Tenth to the Fifteenth Century,' 1880, p. liv.

during the stage of conquest to bring some provender with them, they thus introduced the Black Bindweed (*Polygonum convolvulus*) from Western Asia,[60] the Corn Bell-flower (*Specularia hybrida*) from the Crimea,[61] the Lesser Snapdragon (*Antirrhinum orontium*) from North Africa,[62] the Rough-fruited Bedstraw (*Galium tricorne*) from Thrace,[63] and the Pheasant's-eye,[64] the Larkspur,[65] the Poppies,[66] Lamb's Lettuce,[67] Corn Bluebottle,[68] Corn Marigold,[69] Round-leaved Fluellen (*Linaria*

[60] "L'espèce est venue de l'Asie occidentale temperée en Europe, à une époque peut-être ancienne, car on croit l'avoir reconnue dans Pline (Frass, *Syn. Fl. class*)."—De Candolle, *op. cit.*, p. 683.

[61] Constantinople, if not Rome, probably at an early period obtained corn from the Crimea, where this species grows wild, and its absence in this state from Algeria, cited by DeCandolle (*op. cit.*, p. 674), cannot be taken as a proof that it is not of Roman introduction.

[62] "En Algérie elle abonde. . . . . Son point de départ pourrait bien avoir été le nord de l'Afrique."—DeCandolle, *op. cit.*, p. 677.

[63] "Cette plante, qui croit dans les prés de la Thrace, et qui est également sauvage à Baku et les monts Talysch, n'existe en Allemagne, en France, en Italie, en Angleterre, que dans les terrains cultivés. Ray la mentionnait déjà. Elle est trop obscure, trop difficile à distinguer, pour qu'on puisse savoir si les anciens la possédaient. Elle est en Sicile et en Sardaigne, où même on l'indique dans les champs el les *haies*. Ces localités font supposer une grande ancienneté dans le monde romain; mais elle n'était pas encore connue en 1847 autour d'Alger."—*Ibid.*, p. 668.

[64] "Il est peut-être originaire de Gréce."—*Ibid.*, p. 647.

[65] "L'espèce manque à la Sicile, à la Sardaigne, à l'Algérie, c'est à dire aux pays d'où les Romains tiraient le plus de blé. En Grèce, en Italie, comme au nord des Alpes, on l'indique ordinairement dans les champs; mais vers l'Asie Mineure et le Caucase, les expressions des auteurs de Flores indiqueraient parfois quelque chose de plus sauvage."—*Ibid.*, p. 648.

[66] The poppies are very susceptible to our late summer frosts, and come probably from Greece.

[67] Mr. Watson considered *Valerianella olitoria* as indigenous ('Cybele Britannica,' iii., p. 354); but DeCandolle (*op. cit.*, p. 669) thinks it of Mediterranean origin, pointing out that it occurs "in pascuis herbosis" in Italy and Sicily.

[68] "Évidemment, c'est une plante des montagnes de Sicile, transportée, dés l'origine de l'agriculture, en Italie, et de là dans les régions tempérées, mais qui ne supporte pas la chaleur des plaines autour de son habitation primitive."—DeCandolle, *op. cit.*, p. 669.

[69] Suggested by DeCandolle to be a native of Greece and the Mediterranean islands.

spuria),[70] and Venus' Comb (*Scandix pecten-veneris*),[71] some of which are wild in Italy, whilst others they had themselves derived from the countries that fed the granaries of Rome.

It is somewhat interesting that a species of Nettle still bears the name of Roman Nettle (*Urtica pilulifera*), and haunts among other places the neighbourhood of Cæsar's landing, in connection with which we have a 17th century tradition[72] that the Roman soldiers sowed it that they might use it to beat their chilblains, having heard before coming of the rigours of the English climate.

The Britons no doubt lost much of their culture on the withdrawal of the Romans,[73] nor is it likely that the English invaders introduced many new plants either intentionally or by accident. Their place-names, however, tell us much of the trees, animals, and general character of our county at the time. Thurrock and Oakley tell of the Oak, Bromley and Broomfield of the Broom, Maplestead, Elmstead, and Aldersbrook of three other trees; whilst Broxbourne and Broxted tell of the Badger, Boreham of Wild Swine, Cranham of Cranes, and the many bourns, fords, mers, marshes, wells, holts, and woods of the character of the country on their arrival. In the words of Professor Stubbs (*loc. cit.*) the "vast forests and unreclaimed marsh lands afforded to the new comers a comparatively easy conquest, and the means of reproducing at liberty on new grounds the institutions under which they had lived at home." No doubt many of the Roman improvements had been neutralised by a period of anarchy, and the English soon showed their love of rural life in the numerous "townships," or "hams" with the meadows and other inclosures, "leys," "ings," and

[70] "Seulement dans les terrains de champs en Angleterre, déjà à l'époque de Gerarde. L'espèce est indiquée quelquefois en Italie, hors des cultures, par exemple à Rome sur les bords du Tibre et dans les montagnes."—*Ibid.*, p. 676.

[71] From Sicily.—*Ibid.*, p. 666.

[72] John Parkinson, 'Theatrum Botanicum' (1643), p. 441.

[73] For example, large tracts reclaimed from the sea were again abandoned to the waves. See Pearson, *op. cit.*, p. 4. Stubbs (now Bishop of Chester) 'Select Charters,' 1870, p. 1.

"wicks" that occupied the clearings or "fields." Brentwood tells of one notable clearing by fire, how caused we know not, which may perhaps have produced that open space known as Warley Common, on which in Gerard's time, as now, the swamp-loving *Osmunda* flourished "near unto a place that some have digged to the end to find a nest or mine of gold."[74] The English farmer, whose chief animal food was pork, is likely to have been keenly alive to the value of the "pannage," or food for swine, in the masts and acorns of the common woods of the village; but the increasing demand for bread from a growing population, coupled with the system of the cultivation and fallowing of the common lands by rotation,[75] led no doubt to very extensive clearing between the fifth and the eleventh centuries. The English garden rejoiced in its leeks, onions, garlic, cresses and beans, its strawberries and raspberries, and perhaps even in Honeysuckle and Southernwood,[76] before the coming of Augustine and his followers; and, though possibly during these six centuries there was but little secular communication with the Continent likely to cause the introduction of new plants, we can well believe that those missionaries who showed much worldly wisdom in many matters, and the representatives of the various monastic orders who settled in our land did much for the improvement of the English garden, both in vegetables and in medicinal herbs. Besides mint, sage, rue, dittany, and radishes, they may have re-introduced peas, which had been grown by the Mongols of the Later Stone Age, and parsley, which the Roman colonist can hardly have been without, and possibly cabbages and turnips. Among

[74] John Gerard, 'Herball,' 1597, p. 969.

[75] On this subject see E. Nasse, 'The Agricultural Community of the Middle Ages,' Cobden Club, 1872, especially p. 51, which describes the "three-field husbandry" at Nastock (Navestock) in 1291, and p. 83, where Tusser, an Essex man, is quoted as defending inclosures or "severall" as opposed to "champion" or common land.

[76] These conclusions are based mainly on the existence of purely Teutonic names, especially when others of Latin origin are in use for the same plant. (See Earle, *op. cit.*, and Thomas Wright, 'The Homes of other Days.')

medicinal plants they grew probably the Borage, the Aconite, and the Greater Periwinkle; whilst, at least in that age of greater refinement that intervened between the Danish and the Norman Conquest, the flower-garden may have contained the Marigold, the Pæony, the Daffodil, and the Wallflower. The popular names of the Aconite, "Wolf's-bane" and "Monk's-hood," suggest this period for its introduction: the Daffodil grows in the orchard of the manor-farm, as well as on the site of the monastery or the bower of the dame of the Norman castle, and the Wallflower flourishes on ruins that may belong to this or to a later period. The favourite fruit-tree of the English was undoubtedly the Apple,[77] which gave its name to many places; whilst from the Cistercian Abbey of Warden in Bedfordshire, founded in the 12th century, came those celebrated Warden Pears, that, coloured with Saffron (from Walden perhaps), made that popular mediæval and Elizabethan dish, a Warden Pie.[78]

The history of one plant-name that may have been introduced at this period is remarkable. The Corn-cockle, now universally known as a weed, seems not to have been so known to the ancient Greeks, Romans, Britons, or Germans, but to have come from Northern Russia, where it is known by the same name, "Kukael," as with us.[79] It may be that this was a result of that travelling and commerce which the wisdom of Ælfred encouraged, and perhaps to the same age we may also owe the introduction of the Horse-radish, which also seems to have been of Russian origin.[80]

[77] Frequently spelt "apulder." Perhaps pork and apple-sauce may be a tradition from pre-Norman times; and the blue blouse of the slaughterer of butcher's-meat, a hint of the French invasion of 1066.

[78] Hudson Turner, "On the State of Horticulture in England in Early Times," Archæolog. Journ., vol. v., p. 301. Shakspere, 'Winter's Tale,' Act iv., Scene 2.

[79] This name is suggested to be Celtic, from "coch," red, by Professor Earle, 'Philology of the English Tongue,' p. 20. In Romance languages the plant bears names derived from *Nigella*, e.g., French "nielle," Spanish "neguillon." The Polish "Kakol" and modern Greek κοκκολη seem conclusive in favour of a Slav etymology, as suggested by DeCandolle, *op. cit.*, p. 657.

[80] DeCandolle, *op. cit.*, pp. 654-5.

By the middle of the 11th century, the population having considerably increased, and increasing rapidly, being estimated at less than two millions in England at the Domesday Survey, and at over three millions by the year 1300,[81] the increased demand for corn made the afforestations of the Norman kings felt as a cruel hardship. A Norman hunting-forest was often as much open common as actual woodland; but its essential character was that all tillage within its boundaries was prohibited.[82] Without actual planting having

[81] Professor J. E. Thorold Rogers ('History of Agriculture and Prices') expresses his opinion that the population of England and Wales could not have exceeded two and a half millions in the 14th century. "Such calculations must partly depend on the amount of corn consumed to the head, and modern estimates differ from five and a half to eight bushels. Professor Rogers argues on the higher number, and if the lower be the correct estimate that alone would imply a difference of more than a million in the population."—Pearson, *op. cit.*, p. viii.

[82] "The original significance of the word 'forest' is that land which was outside (Latin *foris*) the 'ham,' 'mark,' or 'ton,'—that is, the home-farm or tilled land of the township—which was not cleared, or felled, not in 'fields,' and not under the same laws as the agricultural land which had itself once formed part of the primæval forest. Thus the forest was part of the 'common' lands of the early village communities, who felled its timber for firewood or for building, and turned their cattle to graze in its open spaces, or to feed on the masts and acorns of its woodlands. Probably large tracts of land in many parts of Great Britain have never been covered with timber trees within the historical period, yet were forests in the strict sense of the word. This forest land was not subject to that periodical redistribution and primitive system of rotation of crops which applied to the 'common fields' of the community; and thus, when the Continental feudalism superseded the early English village system, the forest lands fell more completely into the hands of the Crown and the nobility, the 'lords of the manor,' subject generally, however, to the 'common rights' of topping and lopping, cutting turf, pasturage, &c., varying in different cases."—"The Science and Teaching of Forestry," by G. S. Boulger, 'Journal of Forestry,' 1882. "The forests of England were regarded, at least from the time of the Conquest, as the peculiar and personal property of the king, subject to his uncontrolled jurisdiction, and out of the scope of the common law of the realm. In origin they were probably the remaining unenclosed woodlands which had been national," *i.e.*, communal, "property, and became royal demesne in the eleventh century, . . . enclosed, with very extensive additions, as hunting grounds by the Conqueror and his sons." —Stubbs, *op. cit.*, p. 149.

necessarily taken place, there is no doubt that in this way much of Essex was at this period restored to a wild state. There were the forests of Totham, of Hatfield, of Chelmsford, of Brentwood, of Waltham, including Henhault and Havering, and of Womansfield, near Dagenham, providing in all pannage for 86,471 swine,[83] not to speak of the deer and other game animals that they contained.

Just as modern tourists occasionally add a plant to our gardens, so, no doubt, did those mediæval tourists the Crusaders. It was thus perhaps in the 12th century that we got the Feverfew (*Pyrethrum parthenium*)[84] from Turkey, and the Birthwort,[85] once known as "Saracen's Birthwort." Then, too, may first have been cultivated, in the gardens of the clergy, the Star of Bethlehem (*Ornithogalum umbellatum*), and Our Lady's Thistle[86] (*Silybum marianum*), and from these same gardens may have escaped the medicinal Thorn-apple[87] (*Datura stramonium*), the Pink (*Dianthus plumarius*), the Yellow Fumitory (*Corydalis lutea*), and the Pale, twin-flowered Narcissus (*N. biflorus*).

It is to the Moorish occupation of Spain that we are probably indebted for the introduction from North Africa of the Corn Crowfoot (*Ranunculus arvensis*), which is often a troublesome weed.[88]

[83] Pearson, *op. cit.*, p. 51.

[84] DeCandolle points out that, though wild in Turkey and to the east, this plant seems not to have been known to the Greeks or Romans.—*Op. cit.*, p. 671.

[85] Watson, 'Cybele Britannica,' vol. ii., p. 355.

[86] "Peut-être la découvrira-t-on, vraiment sauvage, en Syrie? Alors, ce seraient les croisés qui l'auraient rapportée et qui auraient introduit dans toutes les langues du midi de l'Europe, et jusqu'en Angleterre, la dédicace à la Vierge Marie."—DeCandolle, *op. cit.*, p. 673.

[87] As to this plant, once thought to be of American origin, DeCandolle sums up a long discussion (*op. cit.*, pp. 731-4) in the words:—"Parait originaire de l'ancien monde, mais probablement des bords de la mer Caspienne ou régions adjacentes, certainement pas de l'Inde, et il est très donteux qu'il ait existé en Europe du temps de l'ancien empire romain; il parait s'être répandu entre cette époque et la découverte de l'Amerique."

[88] Unknown in Greece and wild in Algeria, this species occurs as a weed throughout Western Europe. Though having a remarkable fruit it is

I do not know of any plant that can definitely be said to have been introduced into this country during the Hundred Years' War with France. The accounts of gardens that we read in Chaucer do not differ widely from what we know of those of three centuries earlier, and it was not until the discovery of America and the revival of Medicine and Botany, in common with other learning, that the influence of man was again marked by the introduction of new plants.

Essex agriculture is well presented to our notice, in the condition in which it was during the 16th century, by the 'Hundreth Good Pointes of Husbandrie,' by Thomas Tusser of Rivenhall, published in 1557, and by his 'Five Hundreth Points of good Husbandry,' issued in 1573; and a few years later Gerard, whose 'Herball' appeared in 1597, must have been paying his visits to our county. From his predecessor among botanical writers, William Turner, "the Father of English Botany," we learn that the Annual Mercury (*Mercurialis annua*) was introduced as a vegetable from France,[89] and Gerard tells us of the cultivation before his time of Salsify (*Tragopogon porrifolius*),[90] Alkanet (*Anchusa sempervirens*),[91] and of Snapdragon.[92] The Ivy-leaved Toad-flax was introduced into gardens about the year 1600,[93] and all five of these plants had become more or less common escapes within the next 150 years. During the 16th century also the Small Bugloss (*Lycopsis arvensis*) had apparently been accidentally introduced as a corn-field weed from the South of France, as was also the Least Toad-flax (*Linaria minor*) in the following century, together with the Lesser Bur-parsley (*Caucalis daucoïdes*) and the Night-flowering Catchfly (*Silene noctifolia*). This last is a remarkable plant, having been introduced into Northern Europe, before the time of Ray, apparently direct

not known to have had any distinctive Latin name.—De Candolle, *op. cit.*, p. 647.

[89] 'Herbal,' 1568.

[90] 'Catalogus,' 1596; 'Herball,' p. 595.

[91] 'Catalogus,' 1596; 'Herball,' p. 653.

[92] Both white and red, 'Catalogus,' 1596; 'Herball,' p. 438.

[93] Not mentioned by Gerard, but recorded by Parkinson ('Theatrum,' p. 682) as beginning to spread.

from the Caucasus, since it is not known in the middle of Europe.[94] To the quaint Elizabethan gardens, often alluded to by Shakspere and Milton, and described by Bacon, or at a later date by Addison, many new vegetables and flowering plants had now been introduced from the New World. The first of these to become a naturalised escape in Essex was the Pearly Everlasting (*Antennaria margaritacea*), which Ray himself noticed in a meadow at Bocking.[95] Among his other works it is noteworthy that our great Essex naturalist drew up a special list of the plants of the county,[96] and that among them the Martagon Lily does not occur. This conspicuous plant has, however, been known at Sampford since the beginning of this century; but, though thus undoubtedly of recent introduction, it is in danger of rapid extermination, since the cottagers are in the habit of transplanting it into their gardens.[97] Ray tells us that the Common and Large-leaved Lime were considerably planted in his time,[98] as the Sycamore had been during the preceding century, and no doubt the influence of the 'Sylva' of his great contemporary, John Evelyn, made itself felt in Essex, as elsewhere, in the planting of Oak, Beech, and other timber in the parks that were as numerous as they are now—the common pasture-lands of the old village communities converted into feudal manors.

We have not in Essex been affected by the too zealous enthusiasm of botanists' attempts at the acclimatisation of exotics, nor by the neighbourhood of botanic gardens; but since the middle of the last century the Perfoliate Honeysuckle (*Lonicera caprifolium*), the Yellow Figwort (*Scrophularia vernalis*), the Balm (*Melissa officinalis*), the Coriander, the Tulip, the Snowdrop, the Evening Primrose (an American species), and the Sweet Alyssum (*A. maritimum*), have escaped from gardens and become more or less established in a wild

[94] Ray's 'Synopsis,' ed. Dillenius (1724), p. 340, for this species, and elsewhere for those just mentioned. DeCandolle, *op. cit.*, pp. 656-7.

[95] 'Synopsis,' ed. Dillenius (1724), p. 182.

[96] In Gibson's edition of Camden's 'Britannia,' 1695.

[97] Gibson, 'Flora of Essex,' p. 317.

[98] 'Synopsis' (1724), p. 473; 'Historia Plantarum,' vol. ii., p. 1694.

state. Within the same period a somewhat interesting assemblage of some twelve or fourteen species have been accidentally introduced with foreign seed into our corn-fields, or have become common in a semi-wild state. Among these are the Saintfoin, the Common Flax, the Purple Cow-wheat, the Candy-tuft, Yellow Star-thistle, *Geranium pyrenaicum*, and *Lepidium draba*. The pretty little *Veronica buxbaumii* has spread throughout the length and breadth of England since 1826, not having been noticed in Essex before 1858. The Gold of Pleasure (*Camelina sativa*), a native of Northern Russia, seems to have come to us, either in Flax-seed or in oil-cake, since 1833, and *Alyssum calycinum* since 1835. The notorious American Water-weed (*Anacharis alsinastrum*), unknown in England before 1842, seems to have been partly introduced with cultivated aquatic plants, partly with Canadian timber. The Rough Hawk's-beard (*Crepis setosa*) and *Cuscuta trifolii*, one of the Dodders, were first seen by the late Mr. Gibson in clover-fields in 1843, and the Small-fruited Bedstraw (*Galium vaillantii*), which may, however, have been previously overlooked, was found by the same gentleman in the following year. Only last year I had sent me from Felstead, by the Rev. J. Gepp, *Ammi majus*, a not uncommon casual of late years, from a corn-field, where it was associated with *Centaurea solstitalis* and other similar species.

Time alone, of course, can show how far these recent introductions will become permanent additions to our flora. Our modern high farming, with careful weeding and trim hedgerows, kept clear, as Miss Ormerod advises, of all weeds, lest they harbour noxious insects, may tend rather to the reduction of our list of wild plants than to its increase. This brings me to the conclusion of my subject, the consideration of the future of man's influence on our Flora. More marsh plants will probably share the fate of the *Pilularia* and the Moonwort, even though locally protected from agricultural drainage, as in Epping Forest. The Fritillary seems likely to suffer, owing to its beauty, the same fate as the Martagon Lily, that, namely, of being transplanted bodily into cottage gardens. I fear the *Osmunda* and other ferns will similarly

suffer from our nearness to the metropolis, though our foxgloves and primroses will offer greater difficulties to the exterminators. The Barberry is likely to be eradicated by the farmer fearful of Wheat-rust, and the Deadly Nightshade to disappear slowly from the collecting by druggists and the rooting up of the plants by philanthropic persons anxious to minimise the possibility of children suffering from the fatal habit of subjecting everything to the test of taste.

Agriculture is essentially an interference with the balance of Nature. Man deliberately endeavours to exterminate many plants which he puts to no use, in order to clear a larger area for the few species which he can utilise. As it has been in the past, so it must be in the future.

II.

A Contribution towards the Knowledge of the Arachnida of Epping Forest.

By the Rev. O. Pickard-Cambridge, M.A., C.M.Z.S., &c.

[Read February 24th, 1883.]

Epping Forest, so renowned in the annals of Entomology, has been to me, until the past summer (1882), *terra incognita*. It had long been my wish to have a run in that celebrated locality; it was therefore with much pleasure in the anticipation that I found myself, on the evening of the 8th of June, 1882, in company with Mr. F. M. Campbell, of Hoddesdon, under the hospitable roof of our kind friend, Mr. A. D. Michael, at Theydon-Bois, intent upon a spider-hunt fixed for the following day. On the next morning, after a prolonged and most interesting visit to Mrs. Michael's "nursery" (in which were domiciled some thousands of the minutest Acarids—Oribatidæ—all separately housed, tended, fed, and their life-histories in process of patient and painful working out), we dived at once into our collecting-ground. The Forest here is a wild district of hornbeam, pollards, and underwood, interspersed with old gravel-pits and open spaces of rough herbage and heather, forming a working-ground well calculated to raise hopes of good captures. The sun shone out at first, and boxes and bottles were soon in frequent requisition; but by noon clouds began to gather, and the rest of the day was a succession of heavy thunderstorms, completely putting an end to "collecting" of any kind. The success, however, that we met with during the short time available impressed me with a strong conviction that the Forest only needs working to produce a long list of Arachnids, including probably many rarities, and possibly some new forms. All the species contained in the following list were found on that morning, excepting four—*Marpessa muscosa*,

Clerck, which I met with subsequently (July 25th) near the "Forest School," between Wanstead and Walthamstow; *Theridion formosum*, Clerck, *Attus pubescens*, F., and *Cheiridium museorum*, Leach, found since in the same locality by Mr. R. J. Pickard-Cambridge.

Class—ARACHNIDA.

Order—Araneidea.[1]

Family—Drassidæ.

Drassus lapidicolens, Walck.—Under stones and among roots and *débris* of heather and other plants.

D. infuscatus, Westring. — An exceedingly rare spider; among dead leaves and moss. I feel but little doubt that this spider is identical with *D. criminalis*, Cambr.; the latter being its scarcely-adult female form.

Clubiona compta, C. Koch.—On branches of low trees, and on bushes.

C. terrestris, Westr.—Among dead leaves and moss.

C. brevipes, Blackwall.—On bushes and boughs of low trees.

Micaria pulicaria, Sund.—Under rooty and grassy ledges.

Hecaerge spinimana, Sund.—Dead leaves, moss, and *débris*.

Phrurolithus festivus, C. Koch.—At heather roots, and among dead leaves, &c.

Family—Dictynidæ.

Dictyna arundinacea, Linn.—On low plants.

D. latens, Fabr.—Ditto.

Family—Agelenidæ.

Hahnia montana, Blackw.—Among dead leaves.

Tegenaria derhamii, Scopoli. — In outbuildings near the Forest.

Family—Theridiidæ.

Pholocomma gibbum, Westr. — A rare and curious little spider; among heather stems, and *débris* of herbage.

[1] For descriptions, &c., of the species of this group, see 'The Spiders of Dorset' (Sherborne, 1879-81) by the author, published by the "Dorset Natural History and Antiquarian Field Club," where also references will be found to Mr. Blackwall's magnificent folio, 'The Spiders of Great Britain and Ireland' (London, 1861-64; Ray Society).

THERIDION SISYPHIUM, Clerck. — On low plants and on heather; abundant.

T. FORMOSUM, Clerck.—Two adult females, near "Forest School," Wanstead, June, 1884.

T. VARIANS, Hahn.—On various plants and low boughs of trees; frequent.

T. SIMILE, C. Koch.—On various low plants.

PHYLLONETHIS LINEATA, Clerck.—On bushes and plants of various kinds; frequent.

STEATODA BIPUNCTATA, Linn.—Under rooty ledges.

S. GUTTATA, Wider. — Rather a rare spider; in similar situations with the last.

NERIENE FUSCA, Blackw.—Grass and heather roots.

N. VIVA, Cambr.—A rare spider. Among weeds, &c., in an old gravel-pit.

N. LIVIDA, Blackw.—Among dead leaves.

N. INNOTABILIS, Cambr.—Ditto.

N. HERBIGRADA, Blackw.—Among moss and dead leaves.

WALCKENAERA BIFRONS, Blackw.—On low bushes and branches of trees.

W. PICINA, Blackw.—Under dead leaves,

W. CUCULLATA, C. Koch.—Ditto.

W. ACUMINATA, Blackw.—Females only. Ditto.

LINYPHIA OBSCURA, Blackw.—Rather a rare spider; on low bushes, and often in interstices of bark of trees.

L. TENEBRICOLA, Wider.—On grass and other herbage.

L. BICOLOR, Blackw.—On herbage of various kinds.

L. CONCOLOR, Wider.—Among *débris* and under stones and bits of wood.

L. PELTATA, Wider.—On branches of trees and bushes.

L. TRIANGULARIS, Clerck.—On bushes and low plants.

L. CLATHRATA, Sund. — Among dead leaves and other *débris*.

L. ERICÆA, Blackw.—On grass and herbage.

L. ZEBRINA, Menge.—On grass and among dead leaves and sticks.

ERO THORACICA, Wider.—Among *débris* of sticks and pieces of wood.

Family—Epeiridæ.

Tetragnatha extensa, Linn.—On low plants, bushes, and trees.

Meta segmentata, Clerck.—On bushes and low plants.

M. merianæ, Scopoli.—Under rooty ledges.

Epeira cucurbitina, Clerck.—On bushes and low trees.

E. diademata, Clerck.—Ditto.

Family—Thomisidæ.

Xysticus cristatus, Clerck.—On grass and other herbage.

Family—Lycosidæ.

Ocyale mirabilis, Clerck.—Among herbage of all kinds.

Trochosa terricola, Thorell.—Among dead leaves and herbage.

Lycosa amentata, Clerck.—On grass and low herbage.

L. pullata, Clerck.—Ditto.

L. lugubris, Walck.—Among dead leaves; abundant.

L. annulata, Thorell.—Among short herbage and dead leaves.

L. nigriceps, Thorell.—Among grass, dead leaves, &c.

Family—Salticidæ.

Epiblemum scenicum, Clerck.—Common; running about on walls.

Marpessa muscosa, Clerck.—On old palings; rather abundant, but all immature (July 25th). A local spider; one of the largest British species of this family.

Neon reticulatus, Blackw.—Among dead leaves and moss.

Euophrys frontalis, Walck.—On grass, dead leaves, &c.

Attus pubescens, Fabr.—An adult female (of the very dark variety *sparsus* of Blackwall) near "Forest School," Wanstead, June, 1884.

Order—PHALANGIDEA.

Family—Phalangiidæ.

Phalangium cornutum, Clerck.—Among grass and other low herbage.

P. PARIETINUM, Clerck.—On walls.

OPILIO EPPHIPPIATUS, C. Koch.—On dead leaves and grass.

ORDER—SCORPIONIDEA.

PSEUDO-SCORPIONES. Family—CHELIFERIDÆ.

CHEIRIDIUM MUSEORUM, Leach. —"Forest School," June, 1884.

CHITHONIUS RAYI, L. Koch.—Among dead leaves, &c.

OBISIUM SIMILE, L. Koch.—Ditto.

ORDER—ACARIDEA.

Family—IXODIDÆ.

IXODES RICINUS, C. Koch.—On bushes and trees.

Family—GAMASIDÆ.

GAMASUS CRASSIPES, Hermann.—Among dead leaves.

Family—ORIBATIDÆ.

DAMÆUS GENICULATUS, C. Koch.—Among dead leaves, &c.

NOTHRUS SPINIGER, C. Koch.—Ditto.

Mr. W. Cole tells me that a spider's nest, shaped like an inverted wine-glass (but afterwards plastered with mud), and attached to twigs of broom, rushes, &c., is commonly found in the Forest. This is probably the nest of one of the only two spiders at present known in England as forming such a one—*Agröeca brunnea*, Blackw., or *A. proxima*, Cambr. (Fam. Drassidæ); either or both would be likely to occur in Epping Forest.

[As the above is the first paper on the Arachnida which has been communicated to the Club, it may not be out of place to print the following hints on the methods of practically studying these creatures, which we take from the Introduction to Mr. Pickard-Cambridge's valuable work, 'The Spiders of Dorset,' above referred to. The directions will be of great service to any of our members who may be inclined to take up the study and collecting of spiders and allied animals;—

Mode of Capture and Preservation.

"The study of spiders is peculiarly suited to persons of a sedentary habit, or to those who may love natural history pursuits, but do not desire to form a collection. In this respect the observing of spiders possesses an advantage over the observation of the insect tribes in general, inasmuch as spiders are more stationary, and when found in their hold, corner, or web, do not escape observation by flight, but require only patience in the observer to unfold much of their history and economy. The collector often debars himself from the discovery of many a fact in the habits and life of the object of his search by anxiety to add to his collection, and fear lest the specimen should escape. Still there are many points that can only be ascertained by a close study and examination of the object itself; and, especially in regard to spiders, the scrutiny of those often minute, but important, structural and other characters upon which the determination of their species and systematic position depend is imperative, and hence it is absolutely necessary both to capture and preserve specimens.

"Probably the difficulty of making pretty cabinet objects of spiders has, in some measure, hindered their being studied and collected as commonly as the insect orders. But, premising here that this difficulty can be, in a great degree, overcome, it will be well to say a word first about their *capture* (on the well-known principle of 'First catch your hare.')

"First, then, it ought to be an axiom with the spider-collector never to handle a spider with the fingers if it can possibly be avoided; because they can scarcely be handled without great danger of breaking off the legs, or destroying the hairs, bristles, and spines with which most of them are more or less furnished. To break off these is to deprive oneself of one of the best characters for the determination of the spider; not to mention that the colours and markings often depend on the hairs, and hairy pubescence with which the cephalo-thorax and abdomen are frequently clothed, and which always show sad traces of destruction after contact with the fingers. The only spiders that may be caught without much danger of injury in this way are the very minute ones (especially of the genera *Neriëne* and *Walckenaëra*) upon which the wetted fore-finger may be lightly placed; the moisture causes them to adhere to the finger enough for immersion in the small phial of spirits of wine carried in the waistcoat pocket. Spiders may be boxed (separately of course)

in small pill-boxes; a drop of chloroform stupefies them, and they can then be examined, and rejected if not wanted, or at once placed in the spirit phial, if required for the collection; but the most convenient method of capturing a spider is to place over it an empty test-tube (one of $\frac{1}{2}$ to $\frac{5}{8}$ of an inch in diameter and 3 in. long is a good general size for most British species); the spider instantly runs up the tube (or may be made to do so), the fore-finger then closes the mouth temporarily, and on the inversion of the tube over the open mouth of the spirit phial, the spider drops down at once, and the matter is ended. Ordinary methylated spirit is the best fluid for both killing and preserving spiders; but for the latter purpose (as the spirit is usually about fifty or sixty degrees above proof) it should be diluted with about one-fifth or one-sixth part of distilled water, otherwise it is apt, after a time, to corrugate the integument of small and delicate spiders.

"Those spiders which are found running or jumping about on the ground, or on walls or trunks of trees, can easily be caught thus, by means of a test-tube, with very little practice; for others, which frequent low herbage, a 'sweeping-net' (such as those used by entomologists) must be employed; and for those which live on bushes or boughs of trees, there is nothing better than a very large umbrella, into which the boughs may be beaten; and, whether in the net or umbrella, the pill-box or tube will have to be employed for the transfer of the spiders to the spirit bottle. When the day's collecting is done the contents of this bottle must be sorted into tubes of different sizes, according to their genera and species. This can most conveniently be done by turning out the whole contents of the bottle into the cover of a potted-meat pot, or into a saucer. The spiders should then be separated and placed in the tubes by means of a pair of very fine-pointed and elastic forceps, each spider being taken up by a single leg; the tube is then filled up with clean spirit, a pledget of cotton-wool is placed firmly in its mouth with the forceps, together with a small parchment label, on which (if the label be large enough) the name of the spider is written; or else a number is inserted in figures, referring to a note-book wherein notes of locality or habits, &c., are written. The tube thus filled and stopped is then placed, in an inverted position, in a larger, wide-mouthed bottle, capable of holding several species, or perhaps a whole genus; this wide-mouthed bottle is partly filled with spirit, corked, or stopped with a glass stopper, and has a large label outside, on which the name of the genus and species, or perhaps merely the

number of the tube, may be placed, so as to show its contents and facilitate reference. A larger pair of forceps, with broad flattened points, is necessary for placing the tubes in the bottle, and for taking them out when the spiders are required for examination.[2]

"Spiders preserved after the above method are certainly not objects of beauty, like a collection of moths and butterflies; for, though the colours and markings are usually well enough preserved, the legs are often crumpled up a good deal. To the 'Goodness gracious' sort of naturalists they are by no means acceptable. The only remark my collection elicited from one of this kind was, 'What a lot of bottles!' A little extra trouble, however, in the preparation of a spider will render it worth noticing even by indifferent persons. When stupefied with chloroform, or killed by a short immersion in spirit, the spider should be placed on a piece of cork fixed to a thin layer of lead; a few pins at various points (not through the spider, but between the legs and outside the body) will keep it in a natural position; the whole is then placed in a clean empty jar or basin (a preserved-meat pot is one of the best receptacles I know of), sufficient spirit is poured in to immerse the spider, and the cover is put on. In a fortnight or so the action of the spirit will, if it be pretty strong, have stiffened the specimen, which must then be placed carefully in a tube sufficiently large to receive it without too much compression of the legs; a small strip of white card should be slipped in behind it, the tube be filled up with spirit, and corked (or, better still, stopped with a pledget of cotton-wool) and inverted in a larger bottle, as recommended above. The spider's name may also be written on paper or parchment, and inserted in the tube. Prepared in this way, and ranged on narrow shelves, the spiders may be seen without removing the tubes from the bottles, and they present a very neat and sightly appearance even to the most indifferent observer.

Where to look for Spiders.

"The places in which spiders are found are very various, and no situation wet or dry, high or low, should be left unsearched. In the winter and spring months moss and *débris* of all kinds, such as heaps of grass, cut rushes, fern, dead leaves, brush-wood, and decaying faggots, should be carefully searched, the collector shaking out these various materials over a newspaper, when many a rare species of

[2] Experience has proved that a good black-lead pencil is better for writing on labels, for insertion in spirit, than ink.—O. P.-C.

Neriëne or *Walckenaëra*, as well as some kinds of Drassidæ and others, seldom met with elsewhere, will be found. As spring advances and summer comes on, spiders, as a rule, leave their winter haunts, and get up upon the bushes and trees, and amongst rushes, grass, and other herbage of all kinds, when the sweep-net and umbrella, as above recommended, will come into requisition. At all times in the year spiders conceal themselves under stones, logs of wood, old bark, ivy-stems, and other such shelter; while many species, especially the adult males, may be found running upon the surface of the ground, disporting themselves on walls, tree-trunks, posts, and rails, or running on the uppermost bar of iron fencing. Old buildings, cellars, and unused rooms are also the habitats of some peculiar species. In fact, wherever insect-life can penetrate, spiders of one kind or another are sure to be found; and, as in all other Natural History pursuits, the keenest eye, the most dextrous fingers, and the most unwearied toil and patience, will bring the greatest number of rarities to the Araneologist."—Ed.]

III.

On the Occurrence of the Rhizopod, Clathrulina elegans, *Cienkowsky*, in Essex.

By Charles Thomas, F.R.M.S., F.G.S.

Plate I.

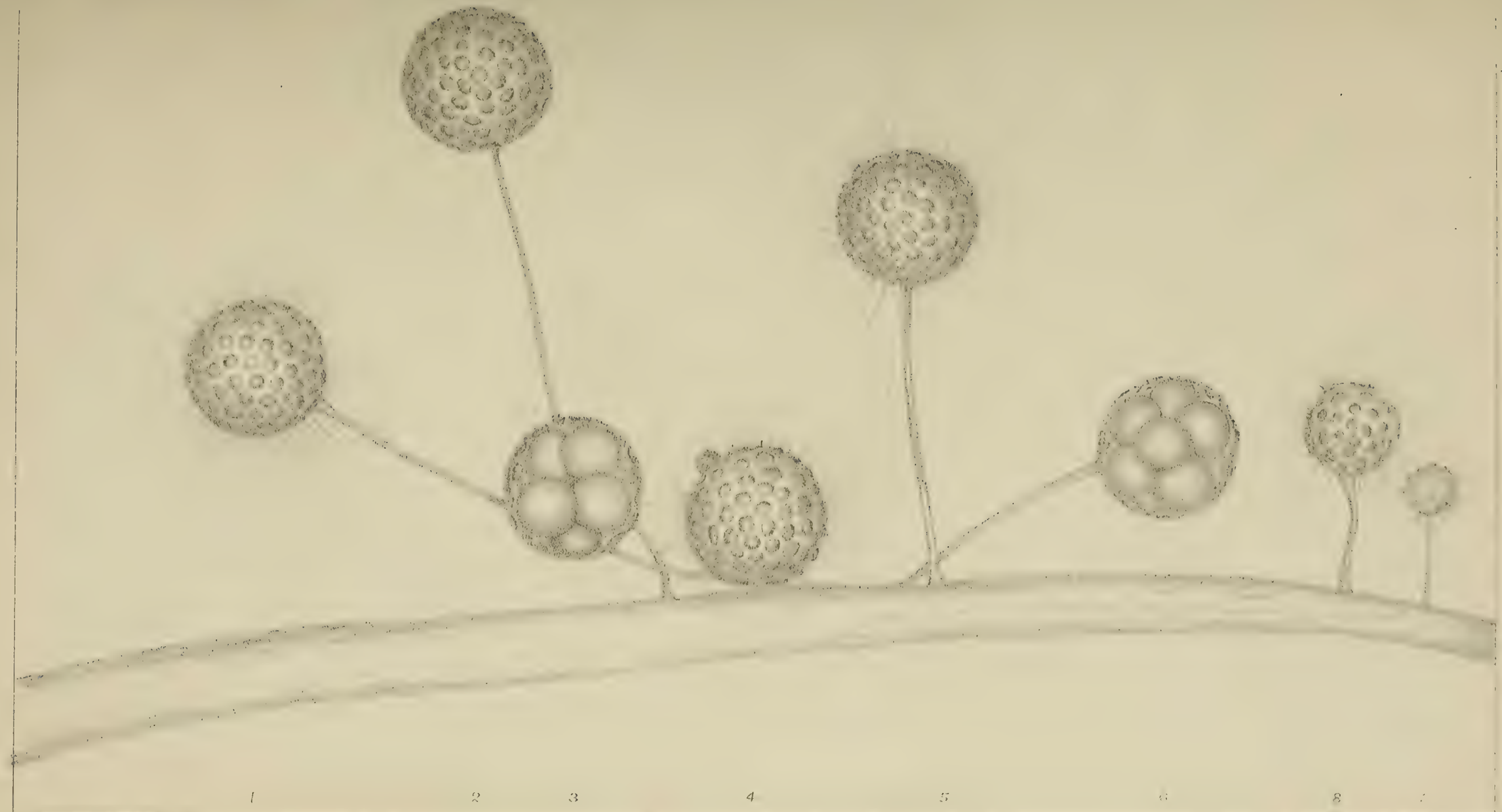
[Read May 24th, 1884.][1]

This beautiful member of the Heliozoan division of the Rhizopoda is said to have been found in Wales and in Ireland, but its occurrence in England has not hitherto been noticed. It is illustrated in the 6th edition of Dr. Carpenter's work on the Microscope, and is there described as possessing "a soft sarode body, encased by a silicious capsule of spherical form, regularly perforated with oval apertures, and supported on a long silicified peduncle."

The specimens figured in the plate were found by myself on the 16th of December, 1882, attached to the decaying part of the root of an old pollarded willow tree by the side of a back-water of the Roding River, near Chigwell Lane, Essex. The water was still, but not stagnant, as it is in direct communication with the stream. The specimens have been kept alive on a slide covered with thin glass until the present time (January, 1883), and frequently observed.

When full grown the globular body is 0·1 mm. in diameter, and it puts forth rays or radiating pseudopodia through the circular or oval apertures in the capsule to the length of fully 0·2 mm. from the circumference; these rays, however, become shorter, and eventually disappear altogether as age is attained. When in full vigour the rays appear instantly

[1] [This short account of Mr. Thomas's observations is published in advance of its order of date at the special request of the author. The Editor feels greatly indebted to Mr. Thomas for the plate accompanying the paper, engraved at his expense, by Messrs. West, Newman & Co., from his original drawings.—Ed.]



C. Thomas del.t ad nat.

West Newman & Co. lith.

CLATHRULINA ELEGANS. — *River Roding. Dec. 16th 1882*

Trans. Essex Field Club. Vol. II. Plate 1.

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to paralyse any minute organisms that may come into contact with them; the captive is sometimes drawn gradually to the body of the *Clathrulina*, and absorbed; but sometimes remains fixed, and the ray to which it is attached becomes thickened, and the body-contents of the prey is conveyed to the interior of the rhizopod as it were through a tube. "Buds" or "spores" [sarcode-bodies] are produced, which appear to come through the holes in the capsule, and which glide about the body and stem of the parent for some time. These bodies then appear to make their way along the root-fibre or other support to which the parent is attached, and to become fixed, eventually growing into the form of the mature *Clathrulina*. Having attained the age at which the rays disappear, the body-substance within the capsule breaks up into spherical masses or "balls," which is probably a process of reproduction; but up to the present time I have not observed that any change takes place in the appearance of the spores, or that they are broken up in any way. The number of "balls" found in each capsule in the natural condition is eight, but in captivity the number formed is less, in a solitary instance being one only. On Plate I. a group of six specimens is shown, each being in the position and condition as when first observed by me. A sketch of a young specimen one day old, developed during my observations, is given in fig. 7, and fig. 8 represents the same at the age of seven days, since which it has not increased in size. Fig. 5 depicts a specimen in full vigour, and fig. 4 one still older, with a "bud" or "spore" [sarcode-body] outside the capsule. Figs. 3 and 6 are optical sections showing the balls within the capsules, and the absence of pseudopodia in that stage; and finally, fig. 2 is an old and possibly decayed specimen, without rays, and apparently consisting only of the spherical silicious capsule, the protoplasmic contents having disappeared.

[Mr. Thomas has suggested our giving, as an *addendum* to the above, a brief sketch of the history of the very interesting organism he has added to our Essex microzoan fauna. *Clathrulina* (so named from its beautiful latticed capsule)

was first found by Cienkowsky near St. Petersburg on water-plants (*Nitella* and *Vaucheria*), and was described by him, in 1867, in Schultze's 'Archiv für Mikroskopische Anatomie.' It was also found by Haeckel near Jena, and by Greef near Bonn; and the form was subsequently detected by Mr. W. Archer in the Callery-bog near Bray, and in Co. Tipperary, Ireland; also in Wales; and by Dr. Leidy in N. America. Mr. Archer at first described it (not being aware of Cienkowsky's discovery) under the name of *Podosphæria haeckelliana* (Quart. Journ. Micros. Soc. viii. (1868) 67). It was always found very sparingly; but Mr. Archer was disposed to think that its distribution would be found to be pretty wide, although perhaps rare in individuals, and restricted to isolated spots. The structure of *Clathrulina* seems to show that it is a protozoön allied to the fresh-water Heliozoa (of which *Actinophrys sol* may be taken as an example), and connecting that well-known form with the marine Radiolaria (the Polycistina of Ehrenberg). It is an exquisitely beautiful object, the protoplasmic body-mass being contained in a superb latticed globe of silica, reminding one of the carved ivory balls cut by the skilfully-patient hands of the Chinese artisans. Figures of it in its various stages will be found in Dr. Leidy's magnificent work, 'The Fresh-water Rhizopods of North America,' forming volume xii. of the United States Geological Survey of the Territories (1879). The peduncle by which it is attached to its point of support is very flexible and of varying length; and in mature individuals, according to Leidy, the homogeneous granular protoplasmic body occupies only the centre of the globular capsule, leaving a space between it and the circumferential walls. Thread-like prolongations of the protoplasm are extruded through the foramina of the capsules, subserving the prehension of food, in the manner so frequently witnessed by microscopists in the case of the common *Actinophrys* of our ditches and ponds. Reproduction appears to take place in four ways:—(α) By fission, as observed by Cienkowsky—the protoplasmic body dividing into two (rarely four) simple granular spheres which pass out of the silicious capsule, and subsequently develop each a stem, and still later a foraminated capsule of its own. (β) By the throwing off of small sarcode bodies, as apparently observed by Mr. Thomas and described above in his notes, which subsequently pass through an *Actinophrys*-like stage, and then secrete the characteristic silicious capsules. (γ) Hertwig and Lesser describe (Archiv. für Mik. Anat. 1874) a third mode in which the body-mass breaks up into a number of smaller masses, each of which becomes surrounded by an

external spinulose membrane. After some time the cysts develop nucleated and flagellated zoöspores, which finally pass through the *Actinophrys*-like and *Clathrulina* stages, as in β. (δ) In this mode (as observed by Sara G. Foulke, Proc. Acad. Nat. Sci. Philad., 1884) the *Clathrulina* withdraws its rays and the protoplasm divides, as above mentioned in section α, but the masses are smooth and transparent. After a period of quiescence, each sarcode mass passed out of the capsule, developed a flagellum, and swam freely about in the water. "Finally it was seen to attach the top of its flagellum to the glass and revolve swiftly for a few moments, when instantly the whole body became spherical, rays were shot out, and the transformed monad was in no point, except that of size, to be distinguished from its *Actinophrys*-like cousin." This reproduction by free-swimming monad-forms may be of great service in securing a widespread distribution of the species, and so preventing its destruction by the dangers attendant upon a too-restricted habitat.

In addition to the references given in the above notes, the reader will find information in Mr. Archer's papers in the 'Quarterly Journal of Microscopical Science' (1868–1877), and in Journ. Roy. Microscopical Soc. for 1884 (Ser. ii., vol. iv., p. 402). It is to be hoped that those of our members possessing the requisite microscopical powers will search for *Clathrulina* in Essex, and endeavour to follow out the various details of its reproduction and development, which are hardly yet thoroughly understood, and which seem to be of very great biological interest.—Ed.]

IV.

On the Lichen-Flora of Epping Forest, and the Causes affecting its Recent Diminution.

By the Rev. James M. Crombie, M.A., F.L.S., &c.

[Read April 28th, 1883.]

The first list of the Lichen-Flora of Epping Forest is that given in Turner and Dillwyn's 'Botanist's Guide,' published in 1805. In this the following fifteen species are enumerated, *viz.*:—

Lichen pinicola.	*Lichen tesselatus.*
,, *sophodes.*	,, *palmatus.*
,, *tigillaris.*	,, *granulatus.*
,, *lynceus.*	,, *subtilis.*
,, *graniformis.*	,, *trapeziformis.*
,, *pezizoides.*	,, *pulmonarius.*
,, *sphæroides.*	,, *vermicularis.*
,, *inquinans.*	

All the above, with the exception of *Lichen pinicola*, *Lichen lynceus*, and *Lichen vermicularis*, are recorded as having been gathered by Edward Forster, jun., who, residing in the district, collected at intervals for nearly half a century the lichens of the Forest. The next list is that given by Mr. Forster himself in his MS. notes interleaved in his copy of the above work of Turner and Dillwyn—a transcript of which, made by your President (Professor Boulger), I have had the advantage of perusing. In this, exclusive of several species from other parts of Essex, as also of some "Spilomas," there are enumerated, in addition to the above, the following forty species, which I have transcribed in the order in which they occur in the MS.:—

Lichen farreus.	*Lichen turneri.*
,, *aipolius.*	,, *scolecinus.*
,, *argenus.*	,, *scalaris.*
,, *coarctatus.*	,, *polycarpus.*

Lichen virellus.
,, *epipolius.*
,, *umbrinus.*
,, *abietinus.*
,, *lutescens.*
,, *contiguus.*
,, *fusco-ater.*
,, *cerinus.*
,, *capitatus.*
,, *lynceus.*
,, *lightfootii.*
,, *cæsius.*
,, *luteus? ?*
,, *jubatus.*
,, *physodes.*
,, *borreri.*

Lichen corrugatus.
,, *agelæus.*
Opegrapha notha.
,, *nimbosa.*
,, *astroidea.*
,, *pulverulenta.*
Arthonia swartziana.
Lichen fragrans.
Opegrapha microscopica.
Lichen salicinus.
Bæomyces cæspiticius.
Urceolaria cinerea.
Lecidea luteola.
,, *luteoalba.*
,, *viridescens.*
,, *cyrtella.*

This therefore gives a total of fifty-five species known to occur in the Forest, though several of them were erroneously named, at the time when the latter of these lists was written. When this was, however, is quite uncertain, though, as may be inferred from the MS., additions were entered as they occurred at different dates. At the same time, as his herbarium contains a far larger number of species and varieties with a more modern nomenclature, most of them were no doubt inserted not many years after the publication of the 'Botanist's Guide.' Unfortunately Forster does not, unless in a few instances, give the date at which he collected the specimens in his herbarium, which, after his death in 1849, was deposited in the British Museum, and is now incorporated with the General British Herbarium in the Botanical Department. From the time of Forster no attention was paid to the lichens of the Forest until the years 1865–68, when I made repeated excursions to it, and added upwards of twenty-five species and varieties, some of which were recorded in my 'Enumeratio Lichenum Britannicorum' (1870), to those formerly collected. During the last two autumns also I have again, for the purpose of this paper, revisited most parts of the Forest, and observed a few things previously overlooked. In the following systematic enumeration I have recorded all the species and varieties, with their habitats

localities, &c., contained in the above list, in Forster's herbarium, and collected by myself during these excursions.

List of the Lichen-Flora of Epping Forest.

Family—Collemacei.

Tribe—Collemei.

Collema furvum, Ach. — On a tombstone in Walthamstow Churchyard, and also in Chingford Churchyard. Sterile (*Hb.* E. F. *s. n. Collema granulatum*). Now extinct.

C. cheileum, Ach. — On walls at Walthamstow. Sterile (*Hb.* E. F.). Now extinct.

Leptogium subtile, Schrad. — Edges of clay-pit near Hale End, in the Forest. Fertile (*Hb.* E. F.). Also on a bank near the Wake Arms. Sterile (J. M. C.).

L. microphyllum, Ach. — On trees between Reevesgate and Copthall Green. Fertile (*Hb.* E. F. *s. n. Collema fragrans*). At High Beach. Sterile (J. M. C.). Now extinct in both localities.

L. palmatum, Huds. — On the Forest, near Hale End. Sterile (*Hb.* E. F.). Not observed by me.

L. lacerum, sub-sp. pulvinatum, Ach.—In the Forest, near the windmill. Sterile (*Hb.* E. F.). Now extinct.

Family—Lichenacei.

Tribe—Caliciei.

Sphinctrina turbinata, Pers. — Parasitic on the thallus of *Pertusaria communis* upon an old oak (since felled) at High Beach (J. M. C.). The only locality in which I have seen it.

Calicium chrysocephalum, Ach. — On barn-doors at Walthamstow (*Hb.* E. F.). I have nowhere seen this species in the Forest.

C. melanophæum, Ach. — On stumps of felled trees near High Beach (J. M. C.). Not seen by me recently.

Var. *ferrugineum*, T. & B. — On pales in a garden in Hoe Street, Walthamstow (*Hb.* E. F.). On old pales at the Warren. Sterile (J. M. C.).

C. hyperellum, Ach. — On old trunks beyond Mount Pleasant, High Beach. Very sparingly (J. M. C.).

C. CURTUM, T. & B. — On garden-pales in Hoe Street, Walthamstow (*Hb.* E. F.). On decayed trunks at Chingford, High Beach, and elsewhere (J. M. C.). Not uncommon.

C. TRACHELINUM, Ach.—On a tree in the Lea Bridge Road, near Walthamstow (*Hb.* E. F. *s. n. C. sphærocephalum*). On stumps in the Wake Valley (J. M. C.).

CONIOCYBE FURFURACEA, L. — On banks, Walthamstow. Fertile (*Hb.* E. F. *s. n. Lichen capitatus* in MS.). Not seen by me.

TRACHYLIA TIGILLARIS, Ach. — On a barn between Wood Street, Walthamstow, and the Forest; also on palings, since destroyed, near Hoe Street (*Hb.* E. F.). Recorded also from Loughton in the 'Botanists' Guide' and the MS. annotations. This species is now evidently extinct in the Forest.

T. TYMPANELLA, Ach. — On old posts and rails about Walthamstow (*Hb.* E. F. *s. n. Lichen inquinans* in MS.). On old stumps in the Wake Valley, and near Ambresbury Banks (J. M. C.).

Tribe—BÆOMYCETEI.

BÆOMYCES RUFUS, Huds. — In a gravel-pit near the King's Oak. Fertile (*Hb.* E. F.). Also in various other parts of the Forest (J. M. C.), but usually sterile.

B. ROSEUS, Pers. — On banks near the King's Oak, in the Forest. Fertile (*Hb.* E. F.). Near the Wake Arms. Fertile (J. M. C.). Also sterile and sparingly elsewhere.

Tribe—CLADONIEI.

CLADONIA ALCICORNIS, Lightf. — On Epping Forest, not far from the Reindeer. Sterile (*Hb.* E. F.). I have not observed this species.

C. PYXIDATA, L.—On heaths and putrid mossy stumps near Chingford, and beyond High Beach. Sterile (J. M. C.).

F. *epiphylla*. — On the ground, Epping Forest. Fertile (*Hb.* E. F.). Not yet seen from any other locality in Great Britain or Ireland.

Var. *chlorophæa*, Flk. — On the ground, Epping Forest. Fertile (*Hb.* E. F. *s. n. Cenomyce pyxidata*). On decayed stumps near Chingford; and at the pond, Wake Valley. Fertile (J. M. C.).

C. FIMBRIATA, Hoffm.—On mossy felled stumps in the Long Running. Sterile (J. M. C.). Apparently very rare.

Var. *tubæformis*, Hoffm. — On decayed stumps at Little Hale, Walthamstow. Fertile (*Hb.* E. F.). On the ground near the British Camp [Loughton ?]. Sterile (J. M. C.).

F. *exigua*, Huds.—On the Forest, near Hale Bank. Fertile (*Hb.* E. F.).

Var. *carneopallida*, Flk. — On mossy stumps near Snaresbrook. Sparingly fertile (*Hb.* E. F.). I have not seen this anywhere in the Forest.

Sub-sp. C. FIBULA, f. *nemoxyna*, Ach. — On Epping Forest. Sparingly spermogoniiferous (*Hb.* E. F.).

Var. *subcornuta*, Nyl. — On the Forest, near the King's Oak. Sterile (*Hb.* E. F.). Neither this nor the preceding has been observed by me.[1]

C. GRACILIS, f. *chordalis*, Flk. — On the Forest, near the Bald-faced Stag. Sparingly fertile (*Hb.* E. F.). On heaths near the Wake Arms. Sterile and sparingly (J. M. C.).

C. FURCATA (*subulata*). — On Epping Forest. Sterile (*Hb.* E. F.). Great Monk's Wood. Sterile (J. M. C.). Not seen by me recently.

Var. *spinosa*, Lightf. — Field near Hoe Street. Sterile. Also near High Beach. Sterile (*Hb.* E. F.). In the latter locality very sparingly and sterile (J. M. C.).

Sub-sp. C. RACEMOSA, Flk.—On the Forest, near High Beach. Fertile (*Hb.* E. F.). Wake Valley (J. M. C.). Very rare.

C. PUNGENS, Flk. — On the Forest, near Haggar Lane. Sterile (*Hb.* E. F.). About the roots of trees in Monk's Wood and at High Beach. Sterile (J. M. C.).

C. SQUAMOSA, Hoffm. — Epping Forest, near Bankers (?). Sterile (*Hb.* E. F.). I have nowhere observed this species.

Sub-sp. C. ADSPERSA, Flk.—On Epping Forest, beyond the Bald-faced Stag. Sterile (*Hb.* E. F.). In the Wake Valley. Sparingly and sterile (J. M. C.).

C. CÆSPITICIA, Flk. — On decayed stumps, Epping Forest.

[1] To some state of this variety is evidently referable the *Lichen vermicularis* of the 'Botanists' Guide,' which certainly was never gathered as alleged by Don S. Rocas Clemente, "amongst mosses on trees in Epping Forest."

Fertile (*Hb.* E. F.). Near the British Camp [Loughton?]. Fertile (J. M. C.).

C. COCCIFERA, L.—On Epping Forest. Sterile (*Hb.* E. F.). On heaths near the Wake Arms, sparingly and sterile (J.M.C.).

C. MACILENTA, var. *scolecina*, Ach. — On Salisbury Hall Pound, Chapel End, Walthamstow. Substerile (*Hb.* E. F.). I have not met with this variety.

Var. *scabrosa*, Mudd. — On old mossy trunks of trees, near the roots, at Monk's Wood, High Beach, and Fairmead Woods. Sparingly fertile (J. M. C.).

Var. *polydactyla*, Flk. — On Epping Forest, between the Reindeer and King's Oak. Fertile (*Hb.* E. F.). On decayed stumps in Fairmead Woods, and near High Beach. Plentiful, but sparingly fertile (J. M. C.).

Var. *ostreata*, Nyl. — On trunks of old trees near High Beach. Sparingly fertile (J. M. C.).

C. FLOERKIANA, f. *trachypoda*, Nyl. — On heaths near the Wake Arms. Fertile, but sparingly (J. M. C.).

CLADINA SYLVATICA, Hoffm. — On Epping Forest. Sterile (*Hb.* E. F.). I have nowhere seen the type, which seems to me to be now extinct, but only the following form.

F. *tenuis*, Flk.—On the ground near High Beach. Sterile (J. M. C.).

Tribe—RAMALINEI.

RAMALINA CALICARIS, Hoffm.—On trunks of trees near Epping Station, at Copthall and Theydon Bois. Sparingly and but rarely fertile (J. M. C.).

R. FARINACEA, L. — On trees near Loughton. Sterile (*Hb.* E. F.). High Beach and Great Monk's Wood. Sterile (J. M. C.). Young states occur also in various parts of the Forest.

R. FRAXINEA, L. — On poplars in the Forest. Fertile (*Hb.* E. F.). Near Epping, High Beach, and Copthall Lodge. Fertile (J. M. C.).

R. FASTIGIATA, Pers. — On trees in Hainault Forest and Theydon Mount. Fertile (*Hb.* E. F.). High Beach, near Royal Oak. Fertile (J. M. C.). Also sterile and stunted in various other parts.

R. POLLINARIA, Ach. -- On trunks near Waltham Abbey. Sterile (*Hb.* E. F.). Near Copthall Lodge. Sterile (J. M. C.).

Tribe—USNEEI.

USNEA HIRTA, L. -- On rails at Walthamstow. Sterile (*Hb.* E. F.). This species is now extinct in the Forest.

U. CERATINA, var. *scabrosa*, f. *ferruginascens*, Cromb.—Hainault Forest, near Hoghill Pond. Sterile (*Hb.* E. F.). Now also extinct.

Tribe—ALECTORIEI.

ALECTORIA JUBATA, L. -- "On some boards on the edge of Hoghill Pond, Hainault Forest," *vide* E. Forster's MS. notes. There is, however, no specimen in *Hb.* E. F., nor have I seen any trace of it in the Forest.

Tribe—CETRARIEI.

CETRARIA ACULEATA, f. *hispida*, Lightf.—At Lord's Pond and Hoghill, Hainault Forest. Sterile (*Hb.* E. F.). On heaths near the British Camp and the "Wake Arms." Sterile (J. M. C.).

PLATYSMA GLAUCUM, L. -- Near High Beach. Sterile (*Hb.* E. F.). No trace of this species is now to be seen in the Forest, and it is evidently extinct.

Tribe—PARMELIEI.

EVERNIA PRUNASTRI, L. — On trees at Walthamstow and in the Forest. Sparingly fertile (*Hb.* E. F.). At High Beach and in various other parts (J. M. C.), but sterile and usually in a stunted condition.

PARMELIA SAXATILIS, L. — On trunks of trees here and there throughout the Forest. Sterile (J. M. C.). Seen only sparingly, and poorly developed.

P. SULCATA, Tayl. -- In a lane between Theydon Gate and Theydon Church; sterile. Also on an oak near the King's Oak, High Beach; fertile. Near Hoghill Pond, Hainault Forest; sterile (*Hb.* E. F.). I have not observed this species.

P. BORRERI, Turn. -- On apple-trees in Hoe Street, Walthamstow. Sterile (*Hb.* E. F.). Near Chingford and at High Beach. Sterile (J. M. C.).

P. CAPERATA, L. -- Near Hoghill, in Hainault Forest;

sterile. Also on palings of a garden, Hoe Street; sterile (*Hb.* E. F.). On old trees in various parts of the Forest; sterile and but little evolute (J. M. C.).

P. ACETABULUM, Neck. — On a lime-tree near Quendon Street, and on an elm opposite the King's Oak, High Beach. Sterile (*Hb.* E. F.). This species is evidently now extinct.

P. EXASPERATA, Ach. — On trunks of trees at High Beach, the Long Running, and other localities. Sterile (J. M. C.).

P. SUBAURIFERA, Nyl.—On trees near High Beach. Sterile and poorly developed (J. M. C.).

P. PHYSODES, f. *labrosa*, Ach. — In a garden, Hoe Street, Walthamstow. Sterile (*Hb.* E. F.). In Forster's MS. notes it is said to occur "in fructification on some boards on the edge of Hoghill Pond," but there is no specimen preserved in his Hb. About High Beach; sterile (J. M. C.). Also sparingly and but little evolute in other localities.

Tribe—STICTEI.

LOBARIA PULMONARIA, L. — On a tree in the Forest, near Loughton. Sterile (*Hb.* E. F.). Evidently now extinct.

Tribe—PELTIGEREI.

PELTIGERA CANINA, L. — Common in the Forest. Fertile (*Hb.* E. F.). At present rather rare, and seldom in fruit (J. M. C.).

P. POLYDACTYLA, Hoffm. — In fields near High Beach, and on the ground here and there in the N. parts of the Forest, but rarely with apothecia (J. M. C.).

Tribe—PHYSCIEI.

PHYSCIA PARIETINA, L. — On old elms near the King's Oak, High Beach. Fertile (J. M. C.). Formerly abundant, but now rare in that locality; also near Epping Station and Copthall, but not common.

F. *cinerascens*, Leight.—Along with the type at High Beach. Fertile (J. M. C.). Now extinct.

P. CILIARIS, L. — On trees near Walthamstow. Fertile (*Hb.* E. F.). I have not seen this species, which is now extinct in the Forest.

P. PULVERULENTA, Schreb. — On an old tree between the Reindeer and King's Oak. Fertile (*Hb.* E. F.). On the road from Epping Station to Epping. Fertile (J. M. C.). The trees in this latter locality have since been felled.

Var. *pityrea*, Ach. — On a tree opposite the King's Oak, High Beach. Sterile (*Hb.* E. F.). Also beyond the King's Oak. Sterile (J. M. C.). Now extinct in these localities.

Sub-sp. P. TENELLA, Scop. — On trees at Walthamstow. Fertile (*Hb.* E. F.). Near Epping. Sterile (J. M. C.). I have not recently seen this subspecies.

P. AIPOLIA, Ach. — On dead branches of a willow-tree in the garden, Walthamstow. Fertile (*Hb.* E. F.). Probably also in old orchards elsewhere, though I have not observed it.

P. CÆSIA, Hoffm. — On tiles, Walthamstow. Sterile (*Hb.* E. F.). I have nowhere seen this species, which apparently is now extinct.

P. ASTROIDEA, Clem. — On the Forest, near King's Oak. Sterile (*Hb.* E. F.). I also formerly gathered it in the same place, but have not anywhere seen it recently.

P. ULOTHRIX, var. *virella*, Ach.—On trees in the Forest near Hale End. Fertile (*Hb.* E. F.). I have nowhere observed this variety.

P. ADGLUTINATA, Flk. — On an apple-tree in garden, Hoe Street, Walthamstow. Sterile (*Hb.* E. F. *s. n. Parmelia elaeina*). I have formerly gathered it also at High Beach.

Tribe—LECANOREI.

PANNARIA NEBULOSA, Hoffm. — On Epping Forest (E. F.), *vide* the 'Botanists' Guide,' and also Forster's MS. notes, *s. n. Lichen pezizoides*. There is no specimen in *Hb.* E. F., and, if ever gathered there, it is now extinct.

LECANORA AURANTIACA, Lightf. — On on ash at Nasing Long Green, Walthamstow (*Hb.* E. F. *s. n. Lichen salicinus*). High Beach, and near the British Camp [Loughton ?] (J. M. C.).

L. FERRUGINEA, Huds.—On a tree in the Forest beyond the "King's Oak," High Beach (*Hb.* E. F.). I have not observed this species.

L. LUTEO-ALBA, Turn.—On an ash-tree near Hale End (*Hb.*

E. F.). Near Copthall Lodge (J. M. C.). Apparently very rare in the Forest.

L. CERINA, Ehrh. — In Hainault Forest, near Widdington (E. F.), *vide* Forster's MS. notes. There is no specimen, however, in his herbarium, nor have I anywhere seen the plant.

L. LACINIOSA, Duf. — On old trees near the King's Oak, High Beach. Sterile (J. M. C.). Now extinct, in consequence of the trees having been felled.

L. VITELLINA, Ehrh. — On a wall (terricole) at Walthamstow. Fertile (*Hb.* E. F.). Also on trees in a wood at Hale End. Fertile (*Hb.* E. F.). I have not myself observed this species.

L. ROBORIS, Duf. — On the Forest, not far from Hale banks (?), (*Hb.* E. F.). On old trees near King's Oak (J. M. C.). Not recently seen, and probably extinct.

L. EXIGUA, Ach. — On tiles at Walthamstow (*Hb.* E. F.). On trees about High Beach, not unfrequent (J. M. C.). Formerly also plentiful near Copthall Lodge.

L. GALACTINA, Ach.—On mortar of brick-walls near Loughton, and at Epping (J. M. C.). Probably also elsewhere.

L. ALLOPHANA, Ach.—On trees near Copthall, and at High Beach (J. M. C.).

L. PARISIENSIS, Nyl.—On trees at Walthamstow (*Hb.* E. F.). I have not observed this species, though it is probably to be found elsewhere.

L. CHLARONA, Ach.—On the Forest, near Salter's Buildings (*Hb.* E. F.). Near Chingford, at High Beach, and near Ambresbury Banks (J. M. C.). Apparently pretty common.

L. ALBELLA, Pers. — On the Forest, near Epping (*Hb.* E. F.). On an old tree near Copthall Lodge (J. M. C.). I have not recently observed this species.

L. ANGULOSA, Ach. — On the Forest, near Loughton (*Hb.* E. F.). Not seen by me, though probably to be detected in other localities.

Var. *sordidescens*, Flk. — On Epping Forest (*Hb.* E. F.). This variety is apparently now extinct.

L. VARIA, Ach. — On rails at Walthamstow (*Hb.* E. F.).

Formerly on trees at High Beach (J. M. C.). Not observed by me recently.

L. OROSTHEA, var. *sublivens*, Nyl. — On the trunks of old trees, near the roots, beyond the "King's Oak," High Beach (J. M. C.). This unusual variety, distinguished from *Biatora straminea*, Stenh., by the livid colour of the apothecia, was for the first time gathered in the above locality, whence it is now extinct in consequence of the trees being felled.

L. CONIZÆA, Ach.—On old pales at The Warren and Copthall. Not uncommon, but rarely fertile (J. M. C.). The sterile thallus is also frequent on pales elsewhere.

L. CONIZÆOIDES, Nyl. — On exposed roots of old beeches in Great Monk's Wood and at High Beach. Plentiful, but often sterile (J. M. C.). This species was for the first time collected in the above localities, but has since been found elsewhere in S. and W. England.

L. PARELLA, f. *tumida*, Pers. — On Epping Forest (*Hb.* E. F.). Near High Beach (J. M. C.). I have not recently observed this species.

Var. *turneri*, Sm. — On the Forest, near King's Oak (*Hb.* E. F.). On an old tree at High Beach (J. M. C.). This seems to be now extinct.

L. CINEREA, L. — On a tombstone in Walthamstow Churchyard (E. F.), *vide* Forster's notes, *s. n. Urceolaria cinerea*. Of this there is no specimen preserved in his herbarium, and it is scarcely likely to be the true plant.

Tribe—PERTUSARIEI.

PERTUSARIA COMMUNIS, DC. — On the Forest (*Hb.* E. F.). Frequent about High Beach, and here and there elsewhere (J. M. C.).

P. GLOBULIFERA, T. & B.—On the Forest, near King's Oak (*Hb.* E. F.). At High Beach (J. M. C.). This species does not occur in its typical state, but only in the form *discoidea* of authors.

P. AMARA, Ach.—On Hainault Forest. Sterile (*Hb.* E. F.). Fairmead Woods, and sparingly in other parts of the Forest (J. M. C.).

P. COCCODES, f. *bacillosa*, Nyl. — At the edge of Hoghill Pond, Hainault Forest. Fertile (*Hb.* E. F.). I have not anywhere seen either the type or this form.

P. FALLAX, Pers. — On Epping Forest and in Hainault Forest. Fertile (*Hb.* E. F.). About High Beach. Fertile (J. M. C.). Occurs also elsewhere, but usually in an imperfect condition.

P. LUTESCENS, Hoffm. — On Epping Forest. Sterile (*Hb.* E. F.). On an old tree, since felled, near the King's Oak. Sterile (J. M. C.).

PHLYCTIS AGELÆA, Wallr.—On trees by the roadside beyond the King's Oak (J. M. C.). Now extinct in that locality, but probably to be detected elsewhere.

P. ARGENA, Flk. — Near the King's Oak, High Beach (*Hb.* E. F.). I have not seen this species in a fertile condition, though what may be the sterile thallus occurs in various parts.

Tribe—THELOTREMEI.

THELOTREMA LEPADINUM, Ach.—On hornbeam at Walthamstow (*Hb.* E. F. *s. n. Lichen inclusus*). At High Beach, and Wintry Wood, near Epping (J. M. C.). Apparently a rare lichen in the Forest.

URCEOLARIA SCRUPOSA, Ach. — On walls of garden, Hoe Street, Walthamstow (*Hb.* E. F.). On mortar of walls at Epping (J. M. C.). I have not recently seen this species.

Tribe—LECIDEEI.

a. *Biatora.*

LECIDEA LIGHTFOOTII, Sm. — On a tree at Walthamstow (E. F.), *fide* Forster's MS. notes. There is, however, no specimen in his Hb., and I have nowhere seen it in the Forest.

L. QUERNEA, Dcks. — On an oak in the Forest (*Hb.* E. F.). Also formerly at High Beach (J. M. C.). I have recently observed only the sterile thallus, and that but sparingly.

L. COARCTATA, Ach.—On bricks in the Forest, near Salter's Buildings (*Hb.* E. F.). Now apparently extinct in the Forest.

L. DECOLORANS, Flk. — On the ground amongst heaths in Lodge Road. Very rare, and seen only in one spot (J. M. C.).

L. FLEXUOSA, var. *æruginosa*, Borr. — On dead decorticated trunks in the Wake Valley. Very sparingly fertile (J. M. C.).

L. ULIGINOSA, Schrad. — On the ground in various parts of the Forest, plentiful near the "Wake Arms," but elsewhere sparingly (J. M. C.).

L. FULIGINEA, Fr.—On old decaying pales and stumps about High Beach, Theydon Bois, and Copthall. Rarely fertile (J. M. C.).

L. DENIGRATA, Fr.—On old rails by the pond in Lodge Road. Very sparingly (J. M. C.). Now extinct in that locality.

L. TRICOLOR, With. — On trees by the roadside beyond "King's Oak," where it was formerly very fine and abundant, but is now scarcely to be seen, except in a spermogoniiferous condition, in which it occurs also in Hawk Wood (J. M. C.).

L. MILLIARIA, Fr.—On the ground near the "Wake Arms." Very sparingly in one spot (J. M. C.).

L. SPHÆROIDES, Dcks. — On a tree in the Forest, between Loughton and Epping (*Hb.* E. F.). A very fine specimen. I have nowhere seen this species.

L. LUTEOLA, Ach. — On trees in Theydon Churchyard, and lane near Debden Green (*Hb.* E. F.). Near Copthall (J. M. C.). Not recently observed by me.

L. TANTILLA, Nyl.—On pales at Hoe Street, Walthamstow (*Hb.* E. F.). Formerly on pales (now removed) in the New Road, behind the "King's Oak" (J. M. C.).[2]

b. *Eulecidea.*

L. CANESCENS, Dcks.—Old trees at Walthamstow. Sterile (*Hb.* E. F.). Near the "King's Oak," High Beach. Fertile (J. M. C.). Also on trees by the roadside in various parts, but always sterile.

L. PARASEMA, Ach.—On trees at High Beach, Copthall, and Wintry Wood, near Epping. Sparingly (J. M. C.).

[2] LICHEN VIRIDESCENS, enumerated in Forster's MS. notes, and said to have been gathered on a wall in Hoe Street, Walthamstow, is not present in his Hb. Certainly it is not *Lecidea viridescens* (Schrad.). So also the specimen of *Lichen graniformis* in Hb. Forster, "On barn-doors, Walthamstow," is too abraded and imperfect to be identified. It evidently is not *Lecidea ehrhartiana*, Ach.

Var. *elæochroma*, Ach.—On hornbeam beyond the "King's Oak." Very sparingly (J. M. C.).

L. CRUSTULATA, Ach.—On flints about High Beach. Rather rare (J. M. C.).

L. CONTIGUA, Ach. — On walls at Walthamstow (E. F.), *fide* Forster's MS. notes. There is no specimen in his Hb., and probably it is not the true plant.

L. PETRÆA, Wulf.—On pebbles at Walthamstow, and on a stone at Epping Forest (*Hb.* E. F. *s. n. Lichen fusco-ater*). On flints here and there in the Forest, plentiful about High Beach (J. M. C.).

L. ALBOATRA, var. *epipolia*, Ach. — On walls about Walthamstow (*Hb.* E. F.). I have not anywhere observed this plant.

L. MYRIOCARPA, DC. — Elms at Higham Lodge, Walthamstow (D. Turner), *fide* Forster's MS. notes, *s. n. Lichen pinicola*. On a tree in field at Hoe Street (*Hb.* E. F.). In Hawk Wood, at High Beach, and elsewhere in the Forest. Not uncommon (J. M. C.).

L. PREMNEA, Ach. — On trees on Epping and Hainault Forests (E. F.), *fide* Forster's MS. notes, *s. n. Lichen abietinus*. Near Chapel Lodge Farm, Hainault Forest; and also near the "Bald-faced Stag," Epping Forest (*Hb.* E. F.). Near the "King's Oak," and Copthall. Sparingly (J. M. C.).

L. OSTREATA, Hoffm.—In garden, Hoe Street, Walthamstow. Sterile (*Hb.* E. F. *s. n. Lichen scalaris*). On palings at The Warren, and Copthall. Sterile (J. M. C.).

L. CARADOCENSIS, Leight. — On decorticated trunks of old trees at Hawk Wood, and near High Beach. Sterile (J. M. C.).

Tribe—GRAPHIDIEI.

GRAPHIS ELEGANS, Sm. — On an old holly near High Beach (J. M. C.). Not seen elsewhere, and now apparently extinct.

F. *coarcervata*, Leight. — On an old ash-tree (since felled) near Copthall Lodge (J. M. C.). Only a single specimen seen.

G. DENDRITICA, Ach. — On Epping Forest, between Woodford Wells and Chingford Hatch (*Hb.* E. F.). Formerly plentiful about High Beach, but now rare (J. M. C.).

G. INUSTA, Sm. — On hornbeam in Hawk Wood, at High Beach, and elsewhere (J. M. C.). Apparently now very scarce, if not altogether extinct.

G. SCRIPTA, var. *pulverulenta*, Pers. — On trees at High Beach, and near the "Wake Arms" (J. M. C.). Rather scarce.

F. *betuligna*, Ach.—On the Forest, near Salter's Buildings, and between Walthamstow and Loughton (*Hb.* E. F.). I have not seen this form.

Var. *serpentina*, Ach.—On trees about High Beach. Very sparingly (J. M. C.).

OPEGRAPHA LYNCEA, Sm. — On Hainault Forest (W. Sowerby); and also on Epping Forest, near the "Bald-faced Stag" (*Hb.* E. F.). Formerly on old trees (since felled) near Copthall Lodge (J. M. C.). Probably now extinct.

O. ATRA, Pers. — Between Hale End and Chapel End (*Hb.* E. F.). Near High Beach (J. M. C.).

Var. *demigrata*, Ach. — At Hoe Street, Hale End, and High Beach (*Hb.* E. F.). Near Copthall, and at Wintry Wood, Epping (J. M. C.).

Var. *hapalea*, Ach.—On the trunks of trees. Sparingly at Hawk Wood and High Beach (J. M. C.).

O. NOTHA, Ach. — On Epping Forest (*Hb.* E. F.). Beyond the "King's Oak," High Beach. Sparingly on a single tree (J. M. C.). I have not recently seen this species.

O. PULICARIS, Hoffm.—On hornbeam near the "King's Oak," High Beach (J. M. C.). Not recently observed by me.

O. BETULINA, Sm. — On hornbeam near the "King's Oak," High Beach (J. M. C.). Formerly not uncommon in several spots, but apparently now extinct. To this is referable *O. turneri*, Leight., and *O. atrorimalis*, Nyl.

O. VULGATA, Ach.—In the garden, Hoe Street, Walthamstow. Various states (*Hb.* E. F.). Also sparingly elsewhere in the Forest (J. M. C.).

O. SUBSIDERELLA, Nyl. — Near Theydon Bois (*Hb.* E. F.). I have not observed this species, though it may probably be still extant in the Forest.

O. HERPETICA, Ach. — Near the "King's Oak," High Beach (*Hb.* E. F.). On Epping Road, beyond Forest Lodge (J. M. C.).

Stigmatidium crassum, Dub. — On the Hawk, near Chingford; and on Epping Forest (*Hb.* E. F.). Near High Beach, formerly plentiful, but now scarce (J. M. C.).

Arthonia astroidea, Ach. — On apple-trees in garden at Hoe Street, and between Hale End and Chapel End, Walthamstow (*Hb.* E. F.). Here and there sparingly in the Forest (J. M. C.).

A. swartziana, Ach.—In the garden, Hoe Street, Walthamstow (*Hb.* E. F.). I have not observed this species (J. M. C.).

A. cinnabarina, Wallr. — On Epping Forest (*Hb.* E. F.). Near High Beach (J. M. C.). Apparently rare in the Forest.

Var. *kermesina*, Nyl. — On hornbeam, Epping Forest (*Hb.* E. F.). Wintry Wood, near Epping (J. M. C.). Also very rare, like the type.

Tribe—Pyrenocarpei.

Endocarpon hepaticum, Ach. — On old ant-hills in Epping Forest, near Salter's Buildings (*Hb.* E. F.).

F. *trapeziformis*, Zoega. — On Epping Forest, near Walthamstow, *fide* Forster's MS. notes. This probably is referable to the type. I have not observed this species, which is possibly now extinct.

Verrucaria nitida, Schrad. — On hornbeam in Epping Forest, beyond Loughton (*Hb.* E. F.). In Hawk Wood, at High Beach, and elsewhere in the N. portions of the Forest (J. M. C.). Formerly plentiful, but now dying out, and seldom found with the spores evolute.

Var. *nitidella*, Flk.—Not uncommon on trees in the Forest (*Hb.* E. F.). Sparingly near High Beach (J. M. C.).

Verrucaria gemmata, Ach.—On the Forest, near Halebank, Walthamstow; and also in Epping Forest (*Hb.* E. F.). Beyond the "King's Oak," and near Copthall Lodge (J. M. C.).

V. biformis, Borr. — On a tree in Mark House Field, Walthamstow (*Hb.* E. F.). In Wintry Wood, near Epping (J. M. C.). Apparently very rare.

V. epidermidis, var. *analepta*, Ach. — On a tree in Hoe Street, Walthamstow (*Hb.* E. F.). Not seen by me.

V. nigrescens, Pers.—On walls, Walthamstow (*Hb.* E. F.

s. n. V. *umbrina*). On flints about High Beach. Rather sparingly (J. M. C.). Probably also elsewhere.

V. VIRIDULA, Schrad. — On brick walls, Hoe Street, Walthamstow (*Hb.* E. F.). Formerly on mortar of a wall at Epping Town (J. M. C.).

From the above list it will be perceived that the number of lichens which have been collected in the Forest during the present century amounts to 171 species, varieties, and forms. Having been carefully examined both by Mr. Forster and myself, it may be assumed that only a very few things, if any, have remained unnoticed, and that we can scarcely expect any further additions to be made to the catalogue. This, compared with that of many smaller woodland tracts, seems rather meagre, and scarcely sufficient to repay the investigations of any but a purely local lichenist. At the same time, as we shall see, this very scantiness is suggestive of various important points connected with the conditions of lichen life and development, which apparently are but little understood by botanists in general. Suffice it at present to observe that, although the Forest extends over a very considerable area, even though no longer coterminous with that of Hainault, now destroyed,[3] yet from its inland situation and general low altitude, the nature of the gravelly and clayey soil, the absence of any large streams or lakes, the manner of growth of the prevailing species of trees, it could not be expected to yield a very rich harvest to the collector. From the remarks made on their distribution in the enumeration given, it is evident that many of the species and varieties formerly gathered are to be expunged from the present lichen-flora of the Forest. This may be estimated at about eighty-five species and varieties, so that there is a decrease of rather more than one-half of the total number collected. As will be gathered also from the said list, the decrease during the interval when Forster ceased collecting and my original visits to the Forest

[3] Although but a very few species from a single locality in Hainault Forest are present in Forster's herbarium, there are good grounds for believing that it was richer in lichens than Epping Forest strictly so-called.

amounted to some forty-six species and varieties, while during the interval between then and my recent visits other forty seem to have shared the same fate.[4] In fact, with a few exceptions, it is now only the more common and generally distributed species that survive. Nor have the lichens of the Forest thus diminished merely in number of species, but also in the quantity in which the survivors occur. This has been very marked since my observations first commenced, and nothing in the character of its lichen-flora is more striking than that species which some eighteen years ago were both general and plentiful are now to be seen only here and there in very small quantity. And not only so, but what is still more singular, many of these are seen only in a sterile or fragmentary condition, presenting often a sickly appearance, as if they were slowly dying out.

What, then, are the causes to which such a great diminution of, and change upon, the lichen-flora of the Forest are to be attributed? Certainly not to any process of decay or death inherent in the lichens themselves; for of all plants they are the longest-lived, and the veritable "patriarchs" of the vegetable kingdom. Indeed so great is the longevity of many species, that, were any of the original trees of the Forest still in existence, we might expect to find flourishing upon them the selfsame individuals which centuries ago appeared upon their trunks and branches. The phenomena under notice are therefore entirely owing to certain external causes which tend directly to the decrease and decay of species. Of these the first and most obvious is the destruction of the older trees,[5] whether by the storms of heaven or the hand of man, in most parts of the Forest. Now it is a well-known fact that lichens, more especially those belonging to the higher genera, are of extremely slow growth, and conse-

[4] But even though thus greatly diminished, the lichen-flora of the Forest compares not unfavourably with some similarly situated woodland tracts, such as Windsor Forest, where poverty is equally marked.

[5] The trees indigenous to the Forest are chiefly oak, hornbeam, beech, and hawthorn, with here and there birch, holly, and maple. In addition to these have been introduced, especially near the towns and villages, ash and elm, which, however, are now but sparingly seen.

quently it is only upon trees that have attained a very considerable age that we can expect to find them fully developed. Hence, when such trees are extensively destroyed, the lichens growing upon them necessarily perish, and, for reasons subsequently to be noticed, their spores, which may have germinated elsewhere upon younger trees, may never become developed into perfect plants. It is no doubt to the wholesale destruction of these older trees, especially oak, ash, and elm, that many of the species in Forster's herbarium, and some of these the most interesting, had become extinct previous to my earlier excursions to the Forest. That this cause has been in active operation since then is entirely confirmed by my recent observations in all parts of the Forest. More especially is this marked in the neighbourhood of High Beach, which, in point of elevation, as also in other respects, was (as it still is in a lesser degree) the best adapted for lichen-growth. As the result of the felling of so many old trees in the portion extending from the "King's Oak" to Copthall and the "Wake Arms," and particularly of those which then lined the roadsides, a large proportion of the lichens in the above list has become either quite extinct or extremely rare. It is true that there are still extensive clumps of old beeches extant in many parts, but here, as generally elsewhere, the beech is remarkably destitute of lichens—the most characteristic, and indeed the only well-developed species here growing upon it being *Lecanora conizæoides*.

Another cause of the diminution of the lichen-flora of the Forest is the want of due access of light and moisture to the existing trees. Lichens have very appropriately been termed by Mr. Berkeley "the creatures of light," inasmuch as none of them grow, or can grow, in dark places, while it is only a few that are rightly developed even in shady places, under special conditions. Their nourishment also is derived not, as has been sometimes alleged, from the different substrata upon which they occur, but exclusively from water—water from the clouds, streams, lakes, or the sea, with the different ingredients contained in it, and suited for their growth. Hence where light and moisture cannot rightly penetrate, lichens must either entirely die out, if they have previously

existed there, or be found only in an ill-developed or abnormal condition. Now, owing partly to the trees in most parts of the Forest being at present too crowded and grouped together, partly to the large quantity of scrub and undergrowth surrounding their stems, and partly to the frequent and general pollarding of the hornbeams, neither sunlight nor rain can find such immediate and direct access to their trunks and branches as lichens essentially require for their due evolution.[6] But for these adverse influences we might have expected that the spores or soredia of such species and varieties as grow upon the old and felled trees would have germinated and gradually developed into perfect plants on the other trees growing in their neighbourhood. This, however, generally speaking, is by no means the case, and it is only on the more isolated trees, occurring in open situations, exposed to sunshine, wind, and rain, that any well-developed lichens are to be found.[7] For though, as already observed, the longest-lived of all vegetables, lichens are at the same time so delicately constituted that, if the atmospherical conditions under which they grow are in any way interfered with, those already developed immediately begin to decay, and those in the process of development speedily perish. Hence, instead of finding the trunks of the trees covered with these "creatures of light and air," we usually find only protohyphæ of species of Pyrenomycetes and various algals, such as *Protococcus*—the "creatures of damp and shade."[8]

[6] Thus also is it that the birch, and more especially the holly, which elsewhere yield a considerable number of species are here so destitute of almost any trace of lichen-growth.

[7] It is to be observed that, though lichens greedily imbibe water for their nourishment, yet when this is not naturally and in due course dried up by the sun and wind having free access to their substrata, it becomes injurious to the life of such species as are not aquatic or semi-aquatic.

[8] According to Schwendenerism, it is just in these circumstances when we have the fungal mycelia ready to lay hold upon the algals, that lichens would be found in various stages of evolution. Facts, however, are in direct antagonism to this hypothesis; and so far from lichens being thus manufactured, I have repeatedly observed in the Forest that when the pro-mycelium of Pyrenomycetes comes into contact with and invests in its meshes the *Protococcus*, the latter is speedily destroyed.

And the last cause to be noticed of the diminution of the lichen-flora of the Forest is the increase and extension of villages in the neighbourhood. It is true that about old rural villages and small towns in most parts of the country a very fair number of lichens may always be gathered, especially of such species as usually occur in cultivated tracts. But where building operations on an extensive scale are being conducted, and the physical features of the old villages are thus entirely altered, and new ones here and there springing into existence, a large decrease, if not the total extinction of previously existing species necessarily results. And this not only from the destruction of old trees, pales, and walls in fields and gardens, but also from the alterations produced upon the surroundings of the natal site of such lichens as remain. For so impatient are they of such alterations which prevent free access of air, that the old habitats become no longer snitable for their growth, and they languish and decay. Hence about Hoe Street, Walthamstow, and Loughton, where numerous species were collected by Forster, as also about Epping Town, where several were formerly gathered by myself, we would at present vainly search for any in a fully-developed condition. The paucity of lichen-growth in these localities, it may here also be observed, is attributable to the atmosphere being in some states of the weather more or less impregnated with smoke from the increased number of human habitations on the outskirts of the Forest, the acids contained in which are most destructive to lichens. Add to this that the direction of the prevailing winds being from the S.W., the smoke and fogs of London and its suburbs extend their deleterious influence at certain seasons of the year to the nearer portions of the Forest, and even considerably beyond; and we cannot be surprised that the result should be a great decrease in the numbers and change upon the condition of its lichens. In fact, in so far as I have more recently observed, these exist only in leprarioid or imperfect states about the villages, the only exception almost being *Lecidea myriocarpa*, which seems better adapted than any other species (unless perhaps *Lecanora galactina*) to withstand the influence of smoke.

Such causes as those now mentioned, tending to the diminution of the lichen-flora of the Forest, were probably more or less at work in the days of Forster; but there can be no question that of recent years they have been much more actively and extensively in operation. It will therefore be very interesting to the lichenist of the future--some fifty or a hundred years hence--to compare the above list of lichens with those that the Forest may then present. Some species belonging to the higher genera extant in Forster's time, and some also belonging to the lower genera, noted in the catalogue as extinct, can never again be expected to occur, since they are not elsewhere to be found within such a measurable distance as that their spores could be readily disseminated in the Forest. But now that the Forest is strictly preserved and left to the operations of natural laws, there is every reason to believe that many species and varieties now germinating and slowly growing upon their different substrata may eventually be found developed into perfect thalli or fertile plants. This, however, must be the work of time: for though readily germinating, the subsequent evolution of lichens is in most cases a very protracted process, resulting from their peculiar twofold manner of life--lethargic in dry, and active only in wet, weather.

V.

On the Sand-Pit at High Ongar, Essex, with a Note on Mr. W. H. Dalton's Paper on the "Blackwater Valley."[1]

By the late Searles V. Wood, the Younger, F.G.S.

[Read February 24th, 1883.]

About one furlong distant from the stream of the Roding River, three furlongs S.S.W. of High Ongar Windmill, two furlongs N. of Hallsford Bridge, and the like distance S.W. from the P. of "Paslowhall Wood," engraved on the inch to

Fig. 1.—High Ongar Sand-pit in 1865; the side facing towards the W.S.W. The darker beds are of brown sandy clay or loam, and the lighter of fine, close, compact, silicious sand. No false bedding apparent. On the face of the pit fronting the south, which is not shown (the pit forming nearly a right-angle), the stratification is about horizontal.

the mile Ordnance Map (Sheet 1), there was, between the years 1860 and 1870, a sand-pit, showing a fine, close, soft, greyish-white, stratified sand with some bands of loam in the lower part, and dipping towards the river at a high angle.

[1] [This paper lacks the benefit of Mr. Wood's final revision. While corresponding with him on the subject, we were startled by the news of his sudden death on December 14th, 1884. Of Mr. Wood's eminence as a student of a very difficult branch of Geology it would not become us to speak; our readers will find a very interesting obituary notice in the

The sand thus disclosed was in the Geological Map which I made from my own survey of Sheet 1 of the one inch to the mile Ordnance issues (and which I in the year 1866 gave to the Library of the Geological Society of London), shown as the Lower Bagshot, with which in all respects it seems identical; but the gentlemen of the Official Survey, when a few years afterwards they worked over Essex, rejected this view on the ground that the sand was at much too low a level for it to be possible; and at page 325 of vol. iv. of the 'Memoirs of the Geological Survey of England' they so state and refer it to the Middle Glacial Sand and Gravel "c" ("c" of my late paper on the Newer Pliocene Period in England).[2]

Although this sand and gravel is present under the chalky clay near the head of the Roding Valley, at Fyfield on the Roding, and at Moreton on the Cripsey Brook, and is represented by some crushed gravel beneath that clay at Willingdale Spain, near Moreton, and also at Stapleford Tawney, Theydon Mount, and Theydon Bois, and by some gravel near the church at Stondon Massey, and Paslow Hall Farm, which has the chalky clay hard by, though not over it (having, so far as exposures reveal the case, been ploughed out and destroyed elsewhere throughout this valley by the ice which filled it during the formation of the chalky clay[3]), yet none of this at all resembles the sand of the High Ongar Pit, from which the gravel at Stondon and Paslow Hall Farm is but a mile distant.

'Geological Magazine' for March, 1885, with a full list of his published papers, so many of which refer to the East Anglian district. To Mr. Wood's kindness and readiness to take the greatest trouble in affording information to enquirers, many besides ourselves would be pleased to bear a testimony of gratitude.—Ed.]

[2] ["The Newer Pliocene Period in England," Parts I. and II. 'Quarterly Journal of the Geological Society,' Vol. xxxvi. (1880), p. 457; and Vol. xxxviii. (1882), p. 667. Mr. Wood has kindly presented annotated copies of these papers, together with a series of explanatory manuscript sections, to the Library of the Club (*vide* 'Proceedings,' February 24th, 1883).—Ed.]

As described in the first part of my paper on the "Newer Pliocene Period in England."

I therefore still believe the sand in question to be what I represented it; and as I suspect that its low position is due to a state of things not yet realised by geologists, though brought to their attention by me nearly twenty years ago, I venture to bring the subject to the attention of the Essex Field Club; because, if my view of the case be correct, the position of the water-bearing sands beneath the London Clay in the neighbourhood of Ongar must be affected by it; and because the case is, I think, probably a part of the same problem which has received so important an illustration by the features disclosed in the boring at Wickham Bishop, which are described by Mr. Dalton in the 'Transactions' of the Club for 1881; the (to all but myself) unexpected results of which boring have caused the waste of a large sum of money by the county ratepayers of Essex.

In a paper in the 'Philosophical Magazine' for the year 1864,[4] I endeavoured to show that the entire system of hill and vale, over that part of England which lies east of a line drawn from the Bristol Channel to Flamborough Head, has arisen from a horizontal displacement of the formations ranging from the Jurassic to the Eocene inclusive, which was caused by two groups of movements; one of which, being the earliest, produced curvilinear contours spreading outwards from three centres where the elastic force giving rise to the feature rose from beneath; and the other of which, being the later, produced rectilinear upthrows from east to west, but was confined to the South of England.

The centres from which, by a radiating lateral thrust, these curvilinear contours originated lie—one near Canterbury, another near the western extremity of the Isle of Wight, and the third in what is now the North Sea; and in the map to the paper I showed how the two latter meeting each other from opposite directions produced contours which crossed those emanating from the Canterbury centre, the result of this crossing being the valley system of East Anglia; and in illustration of the effect of this crossing I pointed out that certain angles in the stream of the Thames thus caused were

[4] 'Philosophical Magazine,' ser. 4, vol. xxvii., p. 180 (March, 1864).

repeated by angles in the streams of the Roding, Stort, Cam, Great Ouse, Nen, and Welland, as shown on the Ordnance Map and in angles of the Royston chalk escarpment, so that radii through the concentric curves of the Canterbury series would intersect them all.

It was (and is) my view that, governed in its action by the lateral displacement thus caused, and by the flexures and fractures which as a consequence took place in the strata beneath the sea which then covered all this area, that sea as its bottom gradually emerged into land wrought the principal part of tbe denudation to which, in combination with the flexures, the system of hill and vale over this part of England is due; though the atmospheric and marine agencies of subsequent times, especially those of the Glacial Period, have added to that denudation, and rendered the configuration thus originally acquired more apparent.

In papers in the 'Quarterly Journal of the Geological Society,' in which I have had incidentally to advert to this subject, I have explained that my researches on the Glacial Beds, during years subsequent to this paper in the 'Philosophical Magazine,' showed me that the view I therein took —that these curvilinear disturbances originated under the Glacial Sea—was erroneous; for the position in which I found the Glacial Beds had shown me that, although the rectilinear group had originated beneath that sea, the curvilinear group had originated beneath an earlier one, which in all probability was that of the Upper Eocene, or of the Oligocene Period, which sea must thus have covered this portion of England to the east of the line before defined; though the deposits of the latter have escaped destruction in Hampshire only, and those of the former are limited to a part only of the area thus defined. The relation borne by the rectilinear group of disturbances to the beds formed under the Glacial Sea is illustrated by Figs. II. to V. of my paper on the Newer Pliocene Period in England, above referred to.

On the map which accompanies the paper in the 'Philosophical Magazine' I depicted the system of hills which had resulted from these curvilinear disturbances, calling it a

system of "arcs"; and by hypothetical lines of diagram section drawn as radii from the respective centres at Canterbury and in the west of the Isle of Wight, through the concentric "arcs" of each of these two series, I showed the flexure which ought to occur at each concentric "arc." I also gave other diagram sections to show the way in which I conceived the denudation had taken place near these flexures, and in consequence of them; though here again I fell into error respecting the connection of the Glacial Beds with these flexures, which my subsequent researches on these beds dissipated,[5] such flexures having been formed long anterior to those beds. The displacements caused by the rectilinear disturbances are not flexures, but upthrusts, as the Figures II. to V. of the Newer Pliocene paper show.

In a paper in the 'Geological Magazine' for 1866 (p. 348), "On the Structure of the Valleys of the Blackwater and the Crouch," having occasion to show the Glacial Beds in relation to the ridge on which Wickham Bishop stands (and which forms a most conspicuous portion of one of the "arcs" of the Canterbury series), I gave a section through the trigonometrical station at that place, and passing through the actual spot where the boring was afterwards made by the Committee of the County Asylum; and I therein described this ridge as originating in the way mentioned in the 'Philosophical Magazine,' and by dotted lines in the section through Wickham Bishop thus given (Fig. 9 of the Plate at p. 348 of the 'Geological Magazine' for 1866), showed the flexure or roll over which I conceived must be concealed in it. At that time no boring had been made to disclose this structure, or, if there had, nothing was known to me of such; and I was led thus to depict what the unfortunate boring afterwards disclosed by no other evidence whatever than the hypothetical one of the case made out by the paper in the 'Philosophical Magazine.' The section, however, given by Mr. Dalton in the 'Transactions' of the Club for

[5] In referring the flexure at Wickham Bishop to a movement beneath the Glacial Sea, Mr. Dalton has, in his communication to the Club in 1881 ("The Blackwater Valley," Trans. Essex F. Club, vol. ii., p. 15), fallen into the same error that I fell into.

1881 (Plate I.), compiled from the evidence of borings, inclusive of that of the Asylum Committee, which he had collected in his official duty as Geological Surveyor of that part of Essex, shows that the flexure in which this ridge has originated is precisely what by these dotted lines I had hypothetically anticipated, though I of course could not tell at what depth from the surface this flexure would bring up the base of the London Clay.

Now, since the line of the Roding River from Woodford to Ongar follows that of the arc of the Canterbury series, of which the rolling ridge at Wickham Bishop is a part, and the angles made by that river in its course are due to the crossing of the arcs of that series by those of the Isle of Wight and North Sea centres in combination, as already mentioned, it appears to me that if the sand of the High Ongar Pit be the Bagshot, it must owe its low position to a similar flexure or roll to that giving rise to the Wickham Bishop ridge, and caused by the lateral displacement of the strata which resulted from the radiating thrusts in which the arc-configuration originated.

With this the high inclination exhibited by the stratification of the High Ongar Sand corresponds; and this inclination being from E.N.E. to W.S.W., it would show that it is to the thrust from the northern centre that the flexure or roll is due. Although the present case is one in *soft* strata, yet the diagram given in the plate to the paper in the 'Philosophical Magazine' to illustrate the removal of the folds by denudation in *hard* strata best illustrates it; and to afford the means of comparison I annex a line of section (Fig. 2), drawn from the Lower Bagshot of Norton Heath, through the High Ongar Pit, to the Roding, in which also the position of the Glacial Beds occurring there is shown.

I do not know the precise elevation of the pit, but estimate its bottom as upwards of 100 feet below the base of the passage beds from the London Clay to the Bagshot Sand,[6]

[6] In mapping geologically the Ordnance Sheet 1, I included these passage beds in the Bagshot; but the gentlemen of the Geological Survey prefer to include them with the London Clay, which causes a

the level of which base, where not covered by the chalky clay (as it is covered at Norton Heath), ranges between 240 and 260 feet above Ordnance datum, and is to be found uncovered by that clay near Frierning, Kelvedon, Hatch Common, Shenfield, Brentwood, South Weald, Havering, and Lambourne End on the east, and Epping and High Beach on the west of the Roding.

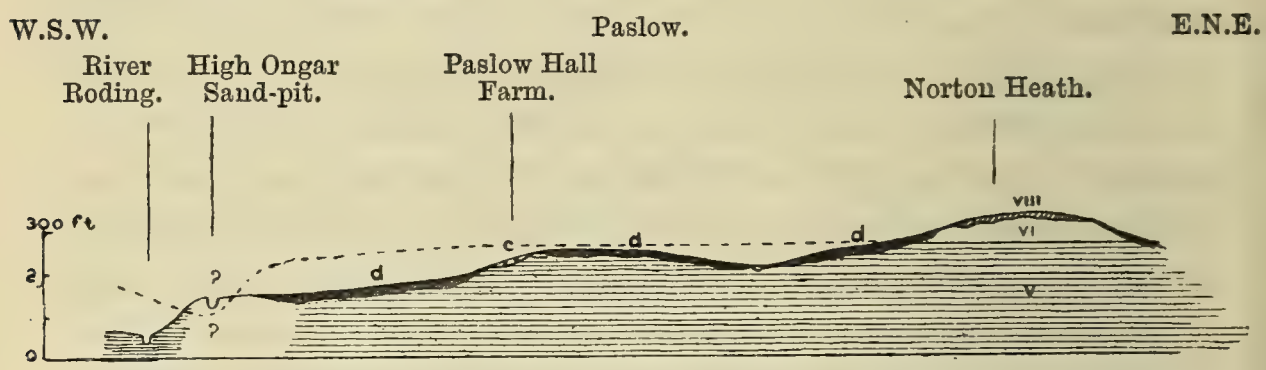


Fig. 2.—References to beds the same as in Memoir on the Newer Pliocene Period in England, *viz.*:—V. London Clay. VI. The Lower Bagshot. VIII. Pebble-beds of uncertain age—probably Diestian (oldest Pliocene), and if not so, of Bagshot age. *c*. Gravel of the Glacial emergence. *d*. The Chalky Clay. *N.B.—There is some gravel also in the Roding Valley-bottom, but it is intermittent and Post-Glacial.*

Appendix.

Note on Mr. W. H. Dalton's Paper on the "Blackwater Valley, Essex."

[Mr. Wood kindly presented to the Library of the Club a copy of his paper in the 'Philosophical Magazine' for March, 1864 (vol. xxvii. (Ser. 4), page 180), entitled "On the Formation of the River- and other Valleys of the East of England," adding thereto in MS. the following remarks (dated December, 1883) upon Mr. Dalton's paper (Trans. Essex F. Club, vol. ii. (1881), p. 15). As these observations appear to be very pertinent to the subjects treated of in the paper on the Ongar Sand-pit, we print them here, with a few verbal alterations, by permission of the author.—Ed.]

considerable variation in our respective delineations of the Lower Bagshot beds in Essex. The alternations of the sand with the brick-earth (or loam) layers in these passage beds are so inconstant that no other line than that which the lowest sand-bed anywhere gives will, in my opinion, serve for a division-line between the London Clay and the Bagshot Sands, the one being merely a continuation of the other by the shoaling of the sea-bottom.

The Committee of the Essex County Lunatic Asylum being compelled to find further accommodation for their patients, purchased a farm at Wickham Bishop, near Witham, exactly upon the crest of one of the arcs from the Canterbury centre, shown in the map to the above-mentioned paper in the 'Philosophical Magazine,' and sank a well for water. This sinking proved to be a total failure, in consequence of the bore passing through a fold in one of the flexures described in my paper "On the Formation of the River- and other Valleys of the East of England," and shown as occurring at every repetition of the arcs in the hypothetical diagram-section, drawn through those spreading outwards from the Canterbury centre, given in that paper.

A description of this bore, accompanied by a section in illustration of it, by Mr. W. H. Dalton, F.G.S., appears in the 'Transactions' of the Club for 1881 (*loc. cit.*).

The line of the diagram-section in the plate annexed to my paper in the Phil. Mag. crosses the arc on which Wickham Bishop is situated, about twelve miles W.S.W. of that place, *viz.*, at Galleywood.

In consequence of the very small linear extent of surface occupied by them, these folds are mostly concealed; and it is only where an excavation, as at Barkway, near Royston, chances to occur over them *exactly*, or a boring, as at Wickham Bishop, happens to hit on one, that evidence of their existence can be demonstrated; but the flexure, I maintain, occurs continuously along every one of the arcs, *ex necessitate*, as a result of the horizontal displacement (caused by the radiating thrust) in which these arcs originated; and it was with this conviction that, having occasion in the 'Geological Magazine' for 1867[7] to give in connection with the Gravels of Essex a section through the ridge at Wickham Bishop Trigonometrical Station, which forms one of the Canterbury arcs, I explained its origin by reference to my above-mentioned paper in Phil. Mag.; and in fig. 9 of the

[7] ["On the Structure of the Valleys of the Blackwater and the Crouch, and of East Essex Gravel, and on the Relations of this Gravel to the Denudation of the Weald." Geol. Mag., vol. iii. (1866), pp. 348-354.—Ed.]

plate to the paper in the 'Geological Magazine' I represented by dotted lines "the great flexure, or rolling earthquake surge," as I there (page 351) called it, from theoretical inference only, *at the very spot where the boring*, made by the Committee of the Essex County Asylum, begun ten years after that, *disclosed its actual existence*, the *fold* in this flexure being, of course, not shown.

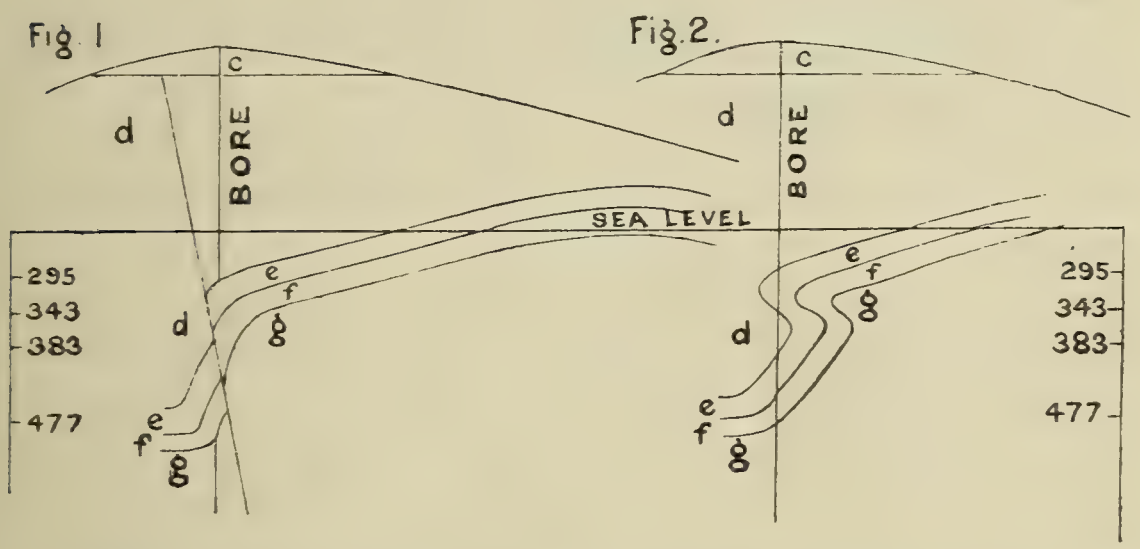
In a communication to the 'Geological Magazine' for November, 1881[8] I called attention to what I had thus predicted, explaining at the same time that my study and mapping (for my own use only) of the Glacial Beds on the east side of England, subsequently to these papers in Phil. Mag. for 1864, and Geol. Mag. for 1866, had shown me that while the *rectilinear* ridges shown in the map annexed to my paper on the River-valleys of the East of England, thus ≡, and as distinct from those of the arc systems, originated during the Glacial submergence,[9] I had been mistaken in supposing the arc-disturbances to have originated during the Glacial Period, as the position of the Glacial Beds relatively to these arcs showed them to have originated prior to the Glacial Period; and that I now regarded them as having arisen from these radiating thrusts having taken place under the old Tertiary sea, during the movement by which the Upper Eocene or Oligocene sea-bed became land; the arcs having acquired their character from the denudation which occurred contiguous to the arc folded as this sea-bed emerged.

In a manuscript memoir on the subject of the Glacial and Post-Glacial Beds which accompanies a Geological Map which I made of sheets 1 and 2 of the Ordnance series (the first of a set eventually made by the help of Mr. F. W. Harmer of all those sheets between the Thames east of London, and the north coast of Norfolk) for the purpose of showing the Glacial

[8] ["Further Remarks on the Origin of the Valley System of the South-eastern half of England, prompted by the result of a Boring near Witham, in Essex." Geol. Mag. 1881. Decade II., vol. ii., pp. 502-504.—Ed.]

[9] The lines of figs. ii., iii., iv., and v. of the plate to the first part of my paper on the Newer Pliocene Period in England (above referred to) are carried through these rectilinear ridges, and show the relation borne to them by the gravel ("b") of the great submergence.

Beds in conjunction with the older formations in the same delineation, I accompanied it by a copy of the Ordnance ten miles to the inch Index-map coloured (in MS.) geologically, on which I inserted by careful reduction from the one inch to the mile sheets the contours of all the arcs which were the subject of the paper on the River-valleys of the East of England in the Phil. Mag., and with that minuteness and care which the scale of that map allowed, and in which they consequently strike the eye more clearly than in the lithographed map to the last-mentioned paper. This manuscript map I presented in 1866 to the Library of the Geological Society, where it can be seen on application to the Librarian.



Wickham Bishop, Essex. Fig. 1.—Mr. Dalton's representation with assumed fault. Fig. 2.—Suggested correction by sinuosity in the fold. *c*. Glacial Gravel; *d*. London Clay; *e*. Reading Beds; *f*. Thanet Beds; *g*. Chalk.

I have added, in manuscript, to the plate of my paper on River-valleys of the east of England placed in the Club's library, a copy of the section at page 25 of the Geological Survey Memoir for sheet 12,[10] which crosses one of the Isle of Wight arcs, and shows the flexure there; and have indicated the direction of it on the map by the line marked "A—B" there. I have also added a copy of the section in a chalk-pit N. of Barkway, on the Royston escarpment brow

[10] 'The Geology of South Berkshire and North Hampshire. Illustrating Sheet 12.' By H. W. Bristow and W. Whitaker. London, Geological Survey.

(fig. 2 on page 8 of Geological Survey Memoir for sheet 47),[11] showing the fold in that arc of the Canterbury series, discovered by the Geological Survey years after the publication of my paper; and as it seems to me that the fault which Mr. Dalton has, in the plate annexed to his paper in the 'Transactions' of the Club, shown as traversing the fold at Wickham Bishop does not exist, and that the features to explain which it has been introduced are simply the result of some sinuosity in the fold, I here (see diagram) give a copy of so much of his representation as that question applies to, and beside it the representation in explanation of the case which I prefer.

[11] 'The Geology of the N.W. part of Essex and the N.E. part of Herts, &c.' By W. Whitaker, W. H. Penning, W. H. Dalton, and F. J. Bennett. London, Geological Survey.

VI.

Miscellaneous Notes on Deneholes, 1883.

By T. Vincent Holmes, F.G.S., M.A.I.

[Read October 27th, 1883.]

I. The Pits at Hangman's Wood, near Grays, visited by the Essex Field Club and the Geologists' Association, June 15th and 16th, 1883.

On Friday, June 15th, the pit marked on the map[1] as No. 4 was inspected by four members of the Essex Field Club, our Secretary, Mr. H. A. Cole, Dr. Cory, and myself. Four visitors also descended in the afternoon, the Rev. T. W. Embleton Thomas, of Greenwich, Mrs. Thomas, and two other ladies. No. 4 was found to be of the double trefoil pattern. Compared with No. 3, it showed a certain amount of irregularity, and a want of finish. The chambers on one side of the shaft were decidedly larger than those on the other, and at the end of each chamber the floor was a rough slope down towards the shaft, 12 or 13 ft. long, which extended to the foot of the rubbish-mound; while in No. 3 the floor is level to the end, or very nearly so. The height of the chambers was also very variable, the highest point reached being about 16 ft. Two sand-pipes were seen above the entrances to two of the chambers, a circumstance worth noting, as pipes in thc chalk are rare when there is any great thickness of beds above the Chalk; the waste of the Chalk under such circumstances being usually even and regular.[2]

Pits Nos. 5 and 6 were visited on Saturday by perhaps twelve or fourteen persons, while the bulk of our visitors were inspecting No. 3. No. 5 is the last of the open shafts. On descending it the double trefoil plan was again disclosed. The height of the chambers was about 18 ft., and the pit

[1] Trans. Essex Field Club, vol. iii., pl. ii.

[2] Whitaker, 'Guide to the Geology of London,' 3rd edit., p. 32.

much resembled No. 3 in size, shape, and general appearance; the thickness of the chalk roof in No. 5 being, however, only 2 ft. In consequence of this thinness, there was a round spot

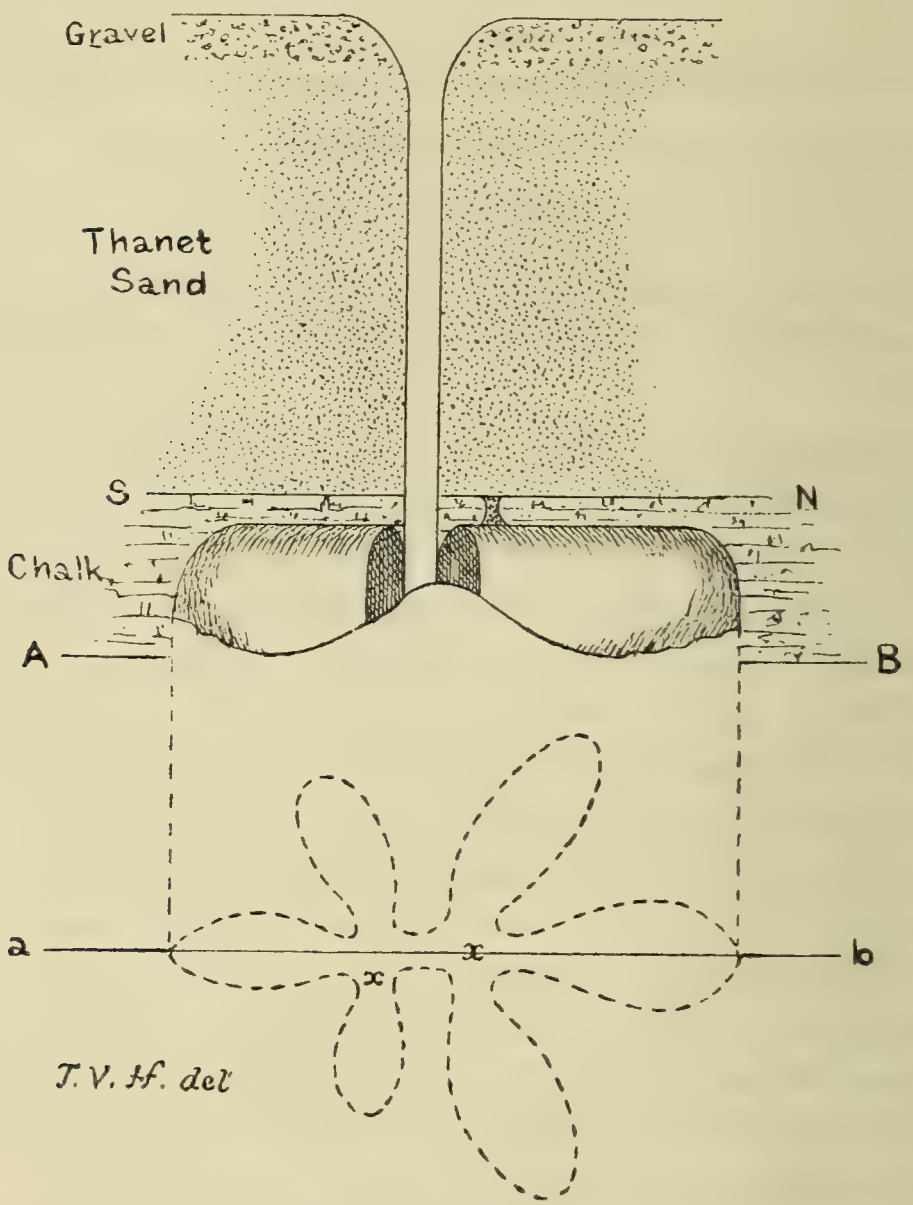


Fig. 1. — Hangman's Wood, No. 4 Pit. Scale 1 in. = 40 ft. Height of chambers 16 ft., except the S.E. and S.W., which are 14 ft. *x*. Position of "pipes" in roof.

in the roof of the chamber next to No. 6, about 2 ft. or thereabouts in diameter, in which the green-coated flints at the base of the Thanet Sand were exposed to view.[3]

[3] That these flints were in place was made manifest by the ignition of some magnesium wire which our Secretary had brought down. I may also mention that among the few who descended No. 5 were our President and the Rev. W. Linton Wilson. I was assisted in taking measurements by Mr. W. E. Martin.

But the most interesting point about No. 5 was the fact that the partition between it and No. 6 had been broken through, so that we thus obtained admission to a shaft-closed pit (No. 6). The shaft of No. 6 appears to be that nearly due east of No. 5, about twenty yards away, on the other side of the parish boundary. No. 6 may consist of either four or six chambers, but, in consequence of the tumbling-in of the shaft, only two of them could be entered. The floor of No. 6 was apparently somewhat higher than that of No. 5, the level of the roof remaining the same; its height therefore was rather less. The two chambers entered were alike in shape, and at one time resembled, in all probability, those of the other pits. But on each side of their semicircular ends the sides of the chambers were indented by recesses of similar shape, but slightly smaller in size, the beginnings of passages intended to join the chambers together, leaving but pillars between their mouths. One of the two chambers of No. 6 was, as nearly as could be measured, 29 ft. 6 in. long from the centre of the shaft; the other, that adjoining No. 5, about 28 ft.

As to the cause of the entrance from No. 5 to No. 6, due to the breaking-through of the partition between them, the evidence seems to me to point towards the conclusion that it is of ancient date, and was made when these Deneholes were in their prime. The proprietors of these two adjoining pits would seem to have recognised their nearness to each other, and to have planned so as, if possible, to avoid communication. The testimony to this in the case of No. 5 is the unusual shortness of the chamber nearest No. 6, though one of the two which are usually the longest. In No. 6 also the chamber adjoining No. 5 is somewhat shorter than the other one entered, though not markedly so. But as, judging from appearances, it seems just as likely that the entrance was accidentally made when rounding off the chamber belonging to No. 5, as in finishing that of No. 6, it seems worth while considering by whom the burglarious entrance was probably effected. The verdict, I think, must be against No. 6. For the facts that the No. 5 people had reduced their floor to a level below that of No. 6, and had made up for unusual

shortness along the line through the shaft-openings by increased size in the other four chambers, marked both that they recognised their nearness to their neighbours and that their pit was the older and more developed one. The No. 6 people, on the contrary, neglected the two ways in which they might have given themselves more room without interfering with No. 5, either by lowering their floor to the level of that of their neighbours or by reducing the partitions between their chambers to pillars. Consequently, in rounding-off the end of their chamber, they (in all probability) made the partition too thin for stability.

II. Notes on the Supposed Deneholes at Easneye Park, near Ware, Visited by the Essex Field Club, June 28th.

In the case of palpable Deneholes, such as those of Grays and Bexley, the problem before us is simply to ascertain their age, and the uses to which they have been put. But with regard to the depressions on the plateau at Easneye Park, it is evident that to explain their existence by the agency of Deneholes is to bring forward a hypothesis, not a demonstration. We must therefore carefully consider the whole of the available evidence to see how far it tends to support the Denehole view, and what, if any, other hypotheses are tenable. For while we of the Essex Field Club are especially familiar with Deneholes as a cause of similar depressions, to a very much larger number of persons the existence of purely natural hollows—analogous to swallow-holes—is sure to seem much more likely, unless careful consideration shows that they cannot apply to the case under discussion.

We have therefore, in the first place, to consider the geological structure of the neighbourhood of Easneye Park; as, even if it should become evident that a geological theory of the depressions there is out of the question, the geology and physical geography of ground in which Deneholes exist should always be carefully noted. For we may fairly assume that the greater the geological difficulties overcome the later must have been the date of the Deneholes themselves.

We saw on June 28th that, directly above the alluvial flats

at the bottom of the valleys of the Lea and Ash, the Chalk was more or less visible, while on ascending the hill-side in Easneye Park we gradually found ourselves on the gravel which caps the plateau on which the house stands, the existence of any beds between the Chalk and Gravel being masked by the sand and gravel that had rolled down the hill-side from the top. On applying for information at the Geological Survey Office, I found that no Drift Map of Sheet No. 47 had been published, but I was kindly permitted by the Survey authorities to take the details given in the map below from a MS. copy for the information of the Essex Field Club.

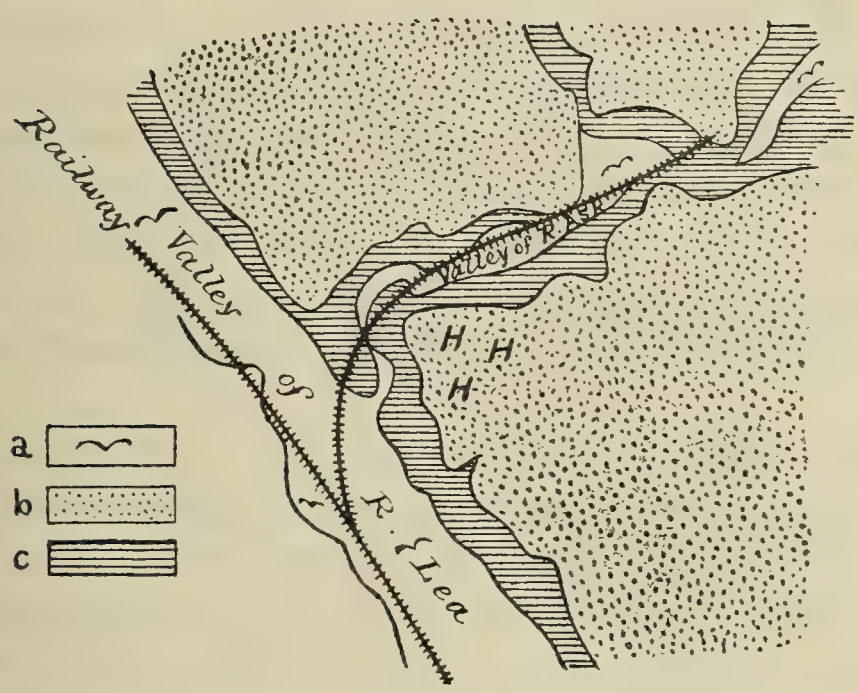


Fig. 2.—Sketch-map to illustrate the geological position of the Easneye Park Deneholes. (From the Geol. Survey Drift-Map, 47, by permission of the Survey authorities). Scale 1 in. = 1 mile. *a*. Alluvium (Marsh). *b*. Beds overlying Chalk (details omitted). *c*. Chalk. H. H. Position of supposed Deneholes.

A comparison of the above Drift Map with the corresponding portion of the published Geological Map of Sheet 47 (which ignores the drift) shows that the Tertiary Beds underlie the Gravel and Boulder Clay of the plateau, and that the escarpment marking their line of outcrop keeps for many miles on the eastern side of the valley of the Ash. In the Geol. Survey Memoir treating of Sheet 47 it is stated that, on the northern edge of the London Tertiary district, "both the

Thanet Sand and the Reading Beds are here so thin and so hidden by Drift that they could hardly be anywhere separated on the one-inch map" (p. 12). The Thanet Sand is in character the same as in W. Kent and S. Essex. The overlying Reading Beds are very thin, and consist of mottled clay, sand, and loam; they rarely reach a total thickness of 40 ft. As the mansion at Easneye Park appears to stand close to the outcrop of the Tertiaries,—below the Drift,—they must be very thin in its immediate neighbourhood. Only a well or boring close to the house could give accurate information as to the nature and thickness of the strata there between the Gravel and the Chalk. For not only are the constituents of the Reading Beds very variable, but, as the overlying Drift Beds lie unconformably above them, the former may have suffered considerably from denudation before the deposition of the latter. More or less clay, however, is usually found in the Reading Beds, and probably at Easneye Park throws out the water which sinks through the gravel above, as it is stated to do about half a mile N.E. of St. Margaret's Railway Station.

Of the Boulder Clay, Brick-earth, and Post Glacial Gravel shown on the map, I need only remark that they overlie the gravel capping the plateau. The outcrop of the London Clay keeps a little eastward of that of the Lower Tertiary Beds, to which it is conformable. It is hardly likely to be present—below the Drift—so far westward as the house, though a small patch of it is shown in a valley between the Reading Beds and the Post Glacial Gravel, in the S.E. corner.

One circumstance—apart from the number of the depressions (twenty-five)—is decisive against the supposition that they may be due simply to natural causes. No hollows are in the least likely to be forming in the chalk of the neighbourhood, inasmuch as the springs at Amwell and New River Head show that it is permanently full of water. The number of the depressions also sets aside any notion that they may be on the sites of old wells. Nor are they at all likely to be on the sites of old excavations for flints in the gravel; from the abundance of unworn flints in the chalk of the valleys

around, the absence of heaps around the hollows, and the growth in size of the depressions themselves.[4] The Denehole hypothesis, therefore, seems to be the only tenable one, and it receives support from the naturally strong position of Easneye Park, in the angles between two river-valleys, the flint flakes on its surface, and the old entrenchment on its weaker side, which mark it as the site of an old hill town or fort. Granting this hypothesis, these Deneholes would seem to present the strongest affinity to those of Blackheath, Charlton, and Eltham, of any we have hitherto visited.

The geology having necessarily been put upon an old Ordnance Map, and the new ones not being yet published, I am unable to show with certainty the site of the house at Easneye Park. The only house at all near the site of the present mansion stands (or stood) on the little outlier of Boulder Clay, and is called Warren Lodge.

III. Notes on a Denehole at Cavey Spring, Bexley, visited by the Sidcup and Crays Field Club, July 7th, 1883.

This Denehole is towards the S.E. corner of Cavey Spring, at the northern end of Joyden's Wood. Stankey Wood, the other spot at which Deneholes are highly concentrated near Bexley, is less than half a mile to the eastward. I was indebted to the Sidcup and Crays Field Club, a newly-formed society, on its second excursion, for a very pleasant afternoon and the opportunity of visiting the Denehole in question.

Though our Hangman's Wood Pits are all of them of great size, and considerably exceed in dimensions those figured by Mr. Spurrell at Stankey, yet we have hitherto met with none in the pillar stage; while the three Stankey examples have all reached that period of existence. And while Mr. Spurrell has doubtless descended the pits at Cavey Spring, he has not given illustrations of any of them in his paper, so that the plan and section accompanying these notes (from measurements taken by Mr. J. Spiller, F.C.S., and myself) will be of

[4] The arrangement of the depressions in pairs at Easneye Park should also be noted as a Denehole characteristic. See account of the Lenham Pits in these notes.

some interest. It will be seen that this pit, though of small size when compared with ours at Grays, is nevertheless in the pillar stage, two being already formed, and two others in process of formation, at the points marked "x." Here and there could be seen pick-marks, as at Grays, and the walls up to a certain height were, as usual, covered with marks of the claws of dogs and other animals, which had fallen in and vainly tried to escape. The shaft was in remarkably good

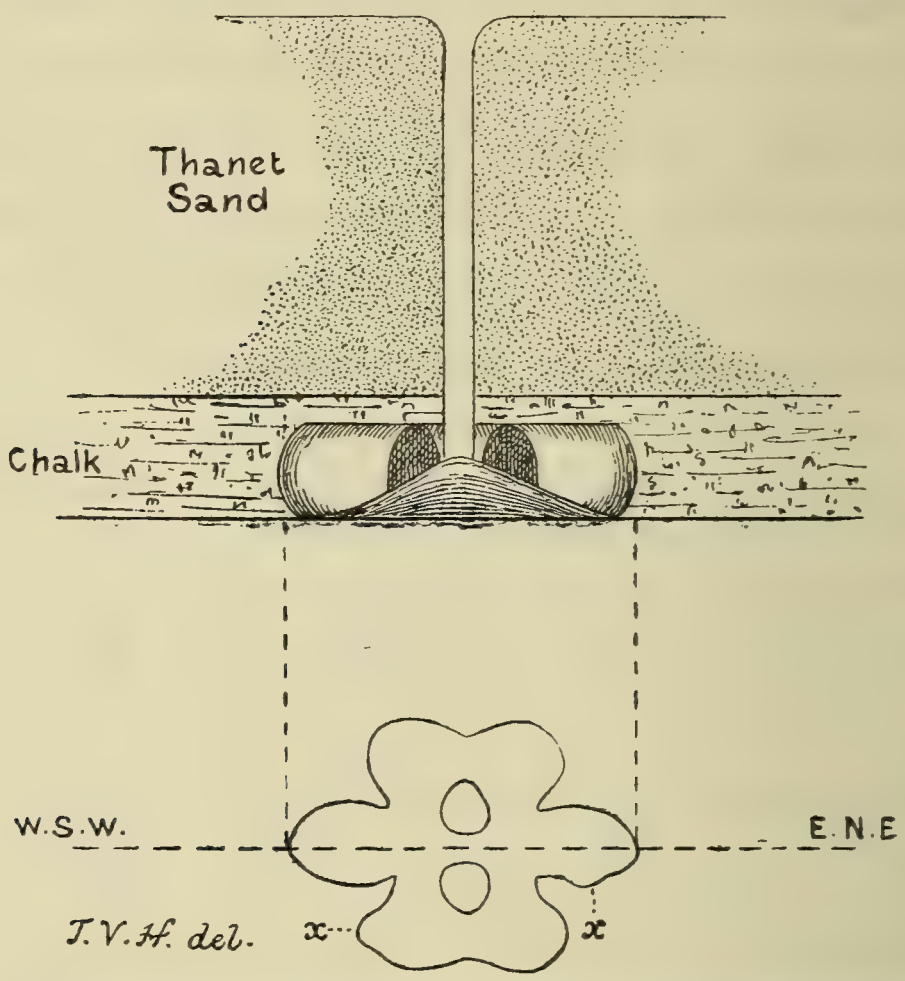


Fig. 3.—Denehole at Cavey Spring, Bexley. Scale 40 ft. to the inch.
"*x*." "*x*." *Points at which the next pillars were being made.*
Length of chamber from W.S.W. to E.N.E. .. *42 ft. 6 in.*
Height .. .. *11 ft. 6 in.*
Depth from bottom of chamber, from surface .. *61 ft. 6 in.*
Thickness of chalk roof .. .. *3 ft. 6 in.*

preservation, the foot-holes being very distinct, and, owing to the absence of the gravel capping the Thanet Sand at Grays, the mouth had been enlarged but slightly. Just above the junction of the Thanet Sand with the Chalk, however, there was a hollow of considerable size on one side. The impression received from a hasty glimpse at this hollow was that it had

been mainly formed by some active creature, such as a wolf, hound, or fox, which, after falling down the shaft, had been either stopped by rubbish at this point or had managed to scramble up to a ledge there from the bottom, which ledge it had afterwards enlarged.

A point worth noting may be raised with regard to the conversion of a six-chambered Denehole into a pillared one. It is this:—The Denehole-chambers were evidently increased in height by the gradual lowering of the floor. But how (it may be asked), when they had attained a height of 16 ft. or 18 ft., were the upper parts of the partitions between the chambers removed, and the roof made smooth and even? The precise mode of operation can be but mere conjecture, but the situation would offer no real difficulty. For that most primitive of ladders, a ragged fir-stem, was in all probability the means of descent into the earliest and rudest Deneholes, in which the bee-hive shape made foot-holes out of the question. And one or two short ladders of this kind would be all that the removers of a partition could possibly require in addition to their ordinary implements.

IV. Notes on the Pits near Lenham, Kent.

Through the kindness of Mr. J. T. Hatch, a well-known resident at Lenham, I had an opportunity, on July 13th, of descending one of the best-preserved pits of this neighbourhood, and was shown by him the positions of several others in various stages of decay. As the pits of this neighbourhood have never, so far as I know, been described before, the following particulars may be of interest:—

The village of Lenham lies at the foot of the Chalk escarpment of the North Downs, about nine miles E.S.E. of Maidstone. Mr. Spurrell has noted the existence of Deneholes about Deptling and Hollingbourne, both similarly situated at the foot of the escarpment, but the first-named eight miles and the latter four miles away towards the north-west. Deneholes are also known, he says, at Wormshill, Bredgar, Stockbury, and Rodmersham, all places on the dip-slope of the chalk, and from two miles to five miles from the

edge of the escarpment.[5] I may now add that they are known in the neighbourhood of Witchling and Lenham.

Mr. Hatch states that they abound very much in his locality, and that he has noted the positions mainly of those on his own land which have concerned him from the agriculturist's point of view. At Witchling is the pit at the bottom of which a young girl once passed fifteen days. She fell down one Saturday evening, and heard the church-bells chime on three successive Sundays before she was released. Probably she had a small quantity of solid food about her when she slipped down; for drink she had as much rain-water as she could catch in a thimble. She is (I was told) still living. Witchling is about two miles from the brow of the escarpment, and two miles and a half from Lenham.

All the pits shown me by Mr. Hatch were on the top of the Chalk escarpment, and within half a mile of its edge, which averages there about 600 ft. above the level of the sea. The highest ground is the narrow belt of country, perhaps half a mile in breadth on the average, on the top of the escarpment and close to the edge, and in this tract of highest ground[6] all the pits we saw were situated. On the north-east side of it the Chalk, much furrowed by valleys, slopes gently down towards Faversham. About a mile and a half N.E. of Lenham is a little cluster of houses, called Warren Street. Two roads lead from its southern end to Rayner's Farm (S.W.) and to Waterditch Farm (S.E.). In the field in the angle between these roads two pits have tumbled in, at the spot where a tree is marked on the six-inch Ordnance Map. They now appear as steep-sided circular holes, perhaps 12 ft. deep and 15 ft. in diameter. In another field close to, but W. of, Warren Street, and on the north side of the road thence to Pivington Farm, are slight hollows marking the positions of five more. This field is the one *crossed* by the parish boundary, which generally runs along the hedges. Towards the middle of the field on the western side of that last named, and north of the parish boundary, three more pits exist where the two

[5] 'Archæological Journal,' 1881, No. 152, p. 396.

[6] The highest point reached is 672 ft. 6 in., near Pivington Farm.

trees appear on the map (6 in. Ord. Map, Sheet 44, Kent). They are very close to each other, and one of them is still of considerable depth. The next pits seen were two near to the N.E. corner of the wood N.W. of Pivington Farm. These two pits are very close together, and are on the line of a hedge which formerly ranged from the corner of the wood to the parish boundary. One of these pits still preserves its original shape, and is about 27 ft. deep. It is much valued as a means of getting rid of worthless carcases, which gradually decay and disappear, leaving but a few bones

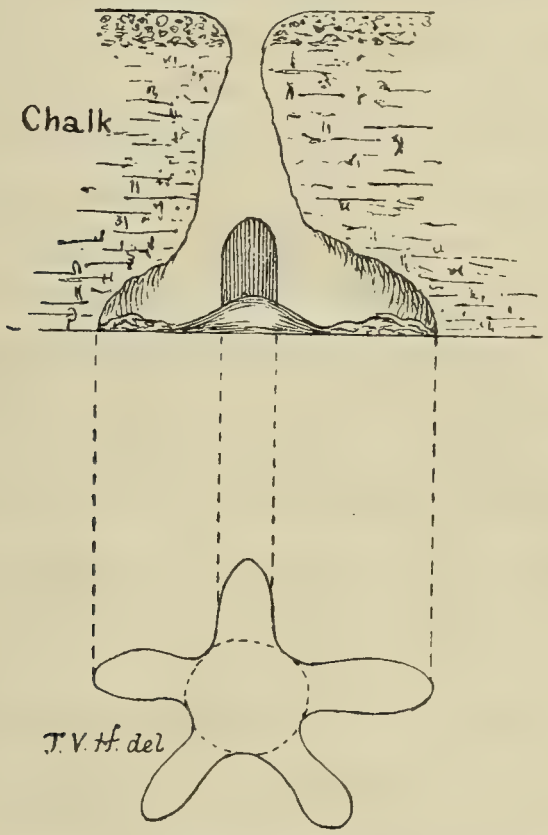


Fig. 4.—Pit near Lenham, between Birch Wood and Woodside Green. Scale 40 ft. to the inch.

behind. From this point we proceeded in a north-westerly direction along the footpath leading from Warren Street to Woodside Green. After passing Birch Wood, three pits very close together were noticed, beside the footpath, in the next irregular strip of wood; and in the border of the wooded patch succeeding it, and about one hundred yards north of the footpath, we came to an open pit. Being the best fitted for investigation, and a good typical example of the whole class, Mr. Hatch had been good enough to furnish the means

of descent in the shape of a long ladder. The pit's depth we found to be about 38 ft., the uppermost five or six feet of the shaft being through loam with flints, the rest of the hole in chalk. The pit appeared to have been at one time of a simple bee-hive shape. From its sides, however, five galleries or tunnels had been driven, which radiated from the centre at nearly equal distances from each other. They varied considerably in height and length. The largest may have been 13 ft. in height at the entrance, and 14 ft. or 15 ft. long; while the smallest was 7 ft. to 8 ft. high at the entrance, and 10 ft. long. From their height at the entrance it is possible that these tunnels may have been begun before the cavern had quite reached its present depth, though possibly the action of frost has assisted, by detaching blocks of chalk, to increase their height to that which we now see, and to add to their irregularity in size.[7] Measuring across from the ends of two nearly opposite tunnels we found the greatest diameter to be about 40 ft., that of the circular space at the bottom of the shaft being about 15 ft. 6 in. At two or three feet below the surface the diameter of the shaft was not more than 4 ft. 6 in., but it remained narrow but for two or three feet.

It is natural that pits such as these, which are known in the districts in which they occur as "draw-wells" or "chalk-wells," and some of which appear to have been utilised in the present century as a means of obtaining chalk for a top-dressing, should be supposed to have been made for that purpose in modern times. But although the arguments against this view are not so conclusive as they would be in the case of the Hangman's Wood Pits, the evidence at Lenham, when carefully examined, by no means favours the top-dressing theory. For while, as before remarked, all the pits visited at Lenham are within half a mile of the edge of the Chalk escarpment, there are large chalk quarries on the brow of the escarpment just below its top, averaging only forty to fifty feet less in height above the sea than the

[7] But it must not be forgotten that a primitive ladder, such as that by which the pit was originally entered, would allow the formation of tunnels of any height.

"chalk-wells." Chalk-quarries naturally abound on the face of the escarpment, and their only peculiarity at Lenham is that they are much nearer the top than usual. This arises from the fact that the "scarp-slope" is there unusually slight and gentle, except close to the top, where it is much steeper. Hence the scarp-slope below a level of about 500 ft. is well-cultivated arable land, while between 500 ft. and 600 ft. is the belt of quarry-ground. But the land for which top-dressing would be mainly required would be the Gault and Lower Greensand below the escarpment, not the ground on its top. For though skilful agriculturists like Mr. Hatch are raising crops around the "chalk-wells," much of the country in which they exist is even now poor, barren, and largely covered by coppice-wood, as described by Hasted, in writing of Wichling and Otterden, a century ago. Hasted makes no mention of the chalk-wells; and yet if any of them had been used in his time for top-dressing he would hardly have failed to note the fact as regards some one of the parishes on the dip-slope of the Chalk, in which they are known to exist.

Are, then, these chalk-wells such as are likely to have been made in the present century for top-dressing? The existence of the quarries close by, at but a slightly lower level, would seem almost sufficient in itself to show the great improbability of this supposition. But, granting the need of a supply of Chalk even nearer at hand, would the construction of "chalk-wells" be the natural and probable way of obtaining it? In Norfolk, where marl-pits for top-dressing abound, we find them at an average distance of two or three hundred yards, more or less, from each other, the pits being open, broader at the top than the bottom, and about five to twenty feet deep. And similar pits, one to a certain number of acres, would have been the natural result of a similar demand at Lenham. While we are compelled to believe—on the top-dressing theory—that the inhabitants of Lenham, instead of trying this simple sort of pit, made the most elaborately troublesome and unprofitable excavations, distributed them over the surface in the most absurd and purposeless way, and went on constructing new ones on the same pattern, to replace

those which had become useless from their excessive liability to tumble in.

On the other hand, the supposition that these chalk-wells are simply Deneholes of the older and simpler type satisfactorily explains their position on the hill-top, close to the heads of the valleys which furrow the dip-slope of the Chalk, and descend towards the north-east. And both their plan of construction and their irregular distribution here and there in twos and threes are intelligible on that hypothesis. On Pl. II. of Mr. Spurrell's paper, Nos. 6, 7, 8, and 9 belong to the Lenham type of Denehole, and in 7 and 8 especially we have a pair in that close proximity to each other of which we have seen so many examples at Lenham, and which is so common among Deneholes generally. But in the heap of sandy clay at the bottom of No. 7 flint flakes and worked scrapers were found below Roman and other remains. The Lenham pits may be either of earlier or later date, but we may fairly infer that they are, in all probability, prehistoric. And their distribution seems to me to point towards the conclusion that each group of two or three marks the position of storehouses once occupied by closely-allied families, or of some similar domestic arrangement common to the race inhabiting this district in prehistoric times.

To some readers many of the foregoing remarks may appear almost unnecessary; but all who are interested in Deneholes find, sooner or later, how strong and general is the feeling in districts where these "chalk-wells" abound that they were originally made for the purpose indicated by the name they bear. Of course there is no necessary improbability in the existence of shafts for such a purpose; there may doubtless be districts in which they would be the most natural means of getting chalk. Whether the pits of any given locality are ancient Deneholes—which may have been more or less utilised in later times—or modern shafts for chalk is a matter of evidence. And it is only by a careful review of that evidence in any given case that we can hope to settle this question, which any amount of mere vague talk about this district and that district would leave just where it was before the discussion.

V. Notes on a Pit in Joyden's Wood, visited November 10th, 1883.[8]

I was also indebted to the Sidcup and Crays Field Club for a pleasant day in Joyden's Wood at the above date. We then descended into a pit more singular than any I had hitherto seen. It is situated near the eastern margin of Joyden's (or Jorden's) Wood, and about 460 yards due east of the "summerhouse" marked on the six-inch Ordnance Map.

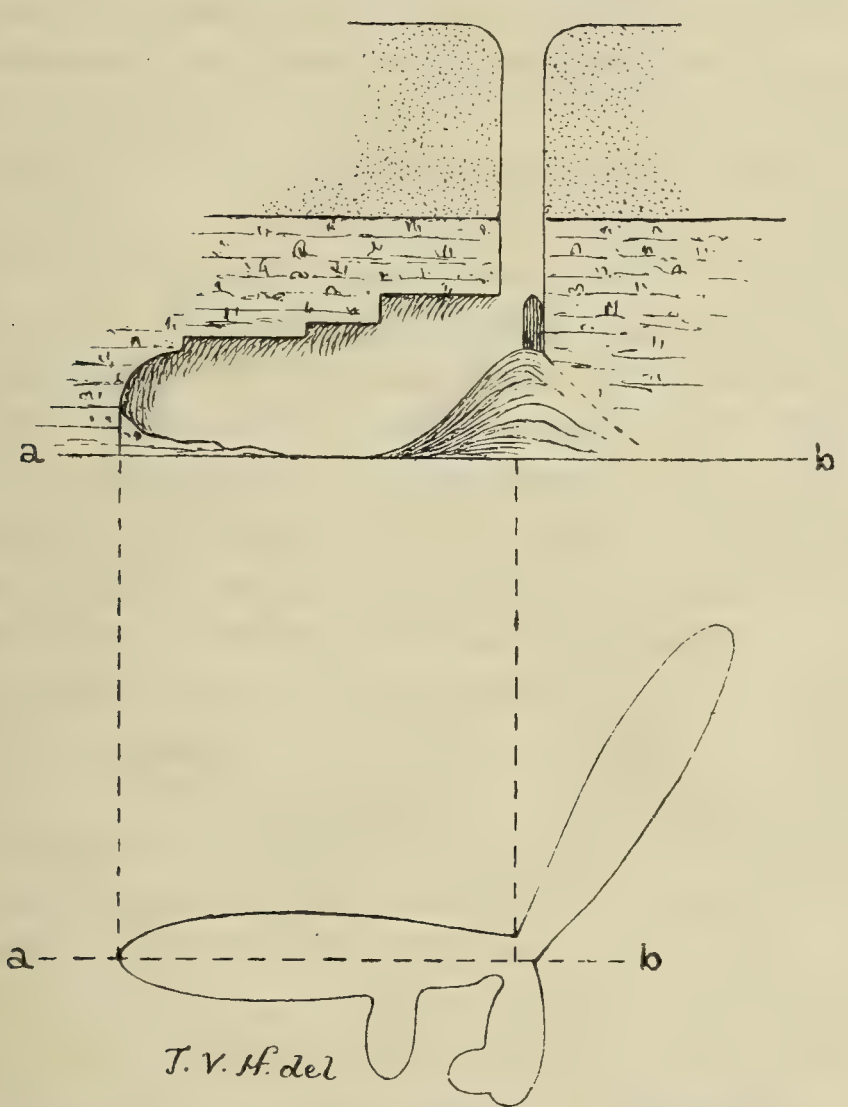


Fig. 5.—Pit in Joyden's Wood, 460 yards east of Summerhouse. Scale 40 ft. to the inch.

We found that the Thanet Sand in its shaft only attained a thickness of 24 ft., instead of the 40 ft. to 60 ft. of shafts in the westerly parts of the wood. A glance at the map showed the existence of open chalk quarries about 280 yards away in a south-easterly direction.

[8] [Since the original paper was read some additional material has come in, which it is thought best to add to the notes. The whole has been carefully revised by Mr. Holmes.—Ed.]

Reference to Pl. II. in Mr. Spurrell's paper in the 'Archæological Journal' shows a pit (No. 1) which has been excavated neither according to the bee-hive nor the double-trefoil plan, but consists of three chambers radiating from the shaft at nearly equal distances apart, the chambers themselves being of about equal size. This pit is situated nearly midway between those at Cavey Spring and that which we descended, and is the only one figured by Mr. Spurrell at all resembling the latter as regards plan of excavation. But while Mr. Spurrell's No. 1 consists of three chambers each measuring 15 ft. or 16 ft. in length (from the centre of the shaft), our pit was found to comprise two chambers 49 ft. long, and a third only 19 ft. And in addition to this striking irregularity in size, the chambers of our pit were found to radiate at very unequal distances from each other. If the shortest chamber be called No. 1, the nearest to it of the two long ones No. 2, and the remaining chamber No. 3, then the amount of this irregularity may be shown by the statement that the angle between the directions of Nos. 1 and 2 was found to be about 90 degrees, that between Nos. 2 and 3, 120 degrees, and that between Nos. 3 and 1, 150 degrees. An additional irregularity was given to the appearance of this pit by the existence of an unfinished attempt to make a communication between Nos. 1 and 2, by means of galleries driven at right angles to the general directions of those chambers. But the gallery from the side of No. 2 being about 11 ft. 6 in. long, while that of No. 1 was scarcely half that length, five or six feet of chalk still remain to be cut through from No. 1. The total depth of the pit was about 52 ft. The thickness of the chalk roof was unusually great, being about 7 ft. 6 in. close to the shaft, while it must have attained 14 ft. or 15 ft. at the further ends of the chambers. The floor was somewhat more uneven than usual, rising considerably towards the ends of the chambers. Considering their length, the two long chambers were very narrow; their height, near the shaft, at least 20 ft. The shaft was about 4 ft. in diameter, having suffered considerably from the weather. While down the pit the chief impression of irregularity was derived from the two recesses made to connect

chambers Nos. 1 and 2, which then seemed out of harmony with the apparent nature of the original design. But on glancing at the plan the object of the connecting galleries becomes at once evident, while the want of equality between the angles at which the chambers radiate is seen to be the really abnormal feature. For the lengthening of the short chamber to equality with the others would doubtless have been the mode by which any increase of size would have been attained, had not development been arrested at the point at which we now see it.

Appendix I.

Critical Notes.

Many members of the Essex Field Club may have seen the correspondence in the 'Essex Times' of July 13th and 20th bearing on our proposed Denehole exploration. For the benefit of those who have not, it may be well to state that a certain "J. W." began the discussion by stating that Mr. C. Roach Smith, the well-known antiquary, was much shocked at the way in which we were wasting our time, and proposing to waste our money over Deneholes. In a letter to "J. W." Mr. Smith had thus expressed himself:—

"I am particularly thankful for the paper you sent me on the Dene or rather Daneholes, for it has fallen to my lot to explain them, which the explorers in Essex and in Kent fail to do. In p. 57 of my 'Retrospections' you will see I refer to what I printed in vol. vi., 'Collectanea Antiqua.' It would only be an act of charity were you to refer the Editor of the 'Express' to this (pp. 243 to 247). They go on in the same innocent way in Kent in making parties to these pits; they descend and describe, go home to prepare for a future descent, but no more; they intimate a belief in the monstrous absurdity of their having been places for refuge and storing corn."

J. W. accordingly advised us to save our money, and buy a copy of vol. vi. of the 'Collectanea Antiqua' instead. Letters from Mr. W. Cole, Mr. F. C. J. Spurrell, and myself appeared in the 'Essex Times' of July 20th vindicating our "innocent" way of considering investigation necessary to the attainment of sound conclusions on the subject of Deneholes, and expressing our opinion that Mr. Smith's explanation not only did not explain them, but was decidedly contrary to the evidence already available. J. W., however, again referred us to the "settlement" of the question in vol. vi. of the

'Collectanea Antiqua,' and as that volume was printed for subscribers only, and has never been published, but few libraries possess it. Consequently a brief discussion of Mr. Smith's article can hardly be thought needless on this occasion, though I am doubtful whether you will consider it "an act of charity" on my part to trouble you with it.

Mr. Smith's article is a very brief one. He begins by stating that the caves on the north shore of the Thames have now and then received some attention from antiquaries, and that Camden concluded that they were of British origin and were constructed for the purpose of storing corn. He does not think, however, that these pits and similar ones in Kent have ever been clearly understood. Then follows an account, from the 'Building News' of Feb. 1st, 1868, of the then latest Denehole-descent, a descent described by Mr. Smith as "an investigation made by some explorers with care and discrimination."

The account quoted from the 'Building News' describes the Deneholes visited as being in "*Hairyman's* Wood, in the parish of Tilbury." On consulting the six-inch Ordnance Map I can find no wood with such a name in either of the parishes of East or West Tilbury. On the other hand, the *Hangman's* Wood of our own descents is situated partly in the parish of Little Thurrock, partly in that of Orsett; while another Hangman's Wood may be seen westward, about half a mile east of Aveley. As regards depth and general character, the pits descended appear to have resembled Nos. 3 and 4 in Hangman's Wood, but no plans or sections are given. By some oversight a pit described as having chambers at the bottom 18 ft. high is also said to have a conical heap of *débris* at the base of the shaft 25 ft. high, which, if true, would certainly have prevented admission into it. But neither this last point nor the uncertainty as to locality are noticed by Mr. Smith, who gives no indication of ever having descended a Denehole himself.[9]

Mr. Smith then dismisses Camden's view, with the remark that it is highly improbable, and brings forward his own, which is that Deneholes are simply pits for procuring chalk. His view has (he says) received confirmation from an agricultural authority, Mr. Bland; and it is established, and conclusive evidence given of the antiquity of these Deneholes, by the testimony of Pliny the naturalist. In speaking of the white chalk Pliny remarks, according to Mr. Smith, that it is obtained "by means of pits sunk like wells with narrow

[9] My object in giving these details is simply to illustrate the careless contempt with which the Deneholes and their uses have been settled.

mouths, to the depth sometimes of one hundred feet, where they branch out like the veins of mines; and this kind is chiefly used in Britain."

I feel that when I state that Mr. Roach Smith's whole case rests on the passage from Pliny just quoted, some incredulity may be felt. Yet so it is! I venture, on the other hand, to assert that no amount of documentary evidence could possibly render unnecessary the most thorough exploration of the pits themselves. But what is the worth even of the documentary evidence that forms Mr. Smith's sole reliance? We have merely the second or third hand information obtained by a notoriously uncritical collector of scraps of knowledge, who had himself never visited Britain. And it is almost certain from Pliny's language—as rendered into English by Mr. Roach Smith—that Pliny's informant had never descended a Denehole. For had he done so he could hardly have spoken of the chambers below as "branching out like the veins of mines." The regular form and the separation of each Denehole from its neighbour must surely have struck the most careless observer. While though the old flint workings at Grimes Graves and Cissbury might be described as "branching out like the veins of mines," yet their shafts are broad, and could never have been described by anyone who saw them as "like wells, with narrow mouths."

Thus, if the quotation from Pliny formed the only available evidence of any kind, it would by no means settle the question as to the original purpose of our Hangman's Wood pits, being, as it is, about equally applicable to them and to those at Grimes Graves. But there is other documentary evidence bearing upon this question. Diodorus Siculus states that the inhabitants of Britain preserved their harvest by cutting off the ears of corn and storing them in pits under ground. For the prevalence of underground storehouses and habitations in all parts of the world, and in both ancient and modern times, I need only refer to Mr. Spurrell's well-known paper in Nos. 152 and 153 of the 'Archæological Journal.' One point, however, seems well worth noting here in connection with documentary evidence bearing on our subject. It is this:—While an ancient writer is hardly likely to testify to the existence of a (to him) peculiar custom, like that of storing corn in underground granaries, without sufficient warrant, his statement that certain peculiar pits *in* chalk were *for* chalk may have no value whatever. For all pits in chalk, whatever the purpose of their excavators, involve the removal of the chalk and its utilisation in some way. And the probability is that Pliny's informant, for example, saw or heard of

pits *in* chalk with vertical entrances, and naturally supposed they were *for* chalk, differing only in form from the quarries he had seen elsewhere. And being a foreigner in Britain, the natives would not be prompt to supply him with information easily withheld, and that might cause them, if given, the most serious loss at some future time. Therefore if, for the sake of argument, we exclude all evidence but documentary evidence, it is plain that Mr. Smith's claim to have settled the question must rest upon an utterly unsound basis.

But if Mr. Smith's opinion is by no means triumphant when documentary evidence alone is considered, the evidence afforded by the Hangman's Wood pits themselves is surely utterly fatal to it. The separation of each pit from its neighbour; their concentration where the chalk is nearly sixty feet below when there is a broad area of bare chalk within a mile; the utter absurdity of their position if we suppose them made either for the supply of top-dressing or of taking a share in the chalk export trade of the Thames; all these things combine to show either that the Hangman's Wood Pits were not *for* chalk or that their makers were lunatics.

I regret that it has been necessary, in vindicating our proposed Denehole exploration, to point out the true worth of Mr. C. Roach Smith's so-called settlement of the question. But the excellent work done by that eminent antiquary at Lymne, Reculver, Richborough, and elsewhere only makes it the more needful to show that his contribution to Denehole literature is of a quite different order.

In conclusion, it occurs to me to note the following matter. I have heard the statement that chalk from some depth is better than that close to the surface, for agricultural purposes, brought forward to show that pits such as those at Hangman's Wood may really have been pits for chalk. It might be deemed sufficient answer to this view to remark that the agricultural marl-pits of Norfolk are invariably broad, open, and shallow. But even granting the possibility that certain people may have thought chalk from 80 ft. or 40 ft. below its surface better than that higher up, it is evident that any inhabitants of the neighbourhood of Grays, holding this opinion, would surely have had sense enough to begin sinking in the chalk itself, less than a mile W. of Hangman's Wood, rather than deliberately choose to go through the utterly useless labour of first penetrating nearly sixty feet of sand and gravel.

Appendix II.

On Rock Granaries.

The following descriptions of subterranean granaries now used in India and South America seem to me worth giving, in the present divided state of opinion as to the original purpose for which Deneholes were constructed. For as these accounts are the work of men who have been for many years resident in the above countries, and as the granaries described are still in use there, we get a fuller and more accurate notion as to their details than can usually be obtained from the quickly-passing traveller, or respecting excavations now neglected, or used for a variety of other purposes.

In a book published in 1878 (London), and called 'Thirteen Years among the Wild Beasts of India, by G. P. Sanderson, Officer in Charge of the Government Elephant-Catching Establishment in Mysore,' the following account is given of subterranean granaries in Southern India:—

"They are usually situated on somewhat high ground, and in gravelly soil or decomposed rock. Their construction is simple. A circular hole about two feet in diameter is dug to three feet in depth, when a domed chamber of an oval shape is excavated, capable of containing from ten to twenty cart-loads of grain. Neither masonry nor props are used. A little straw is laid on the floor, and against the walls of the chamber to a third of their height, when the grain is filled in. A slab is placed over the pit at the bottom of the short shaft that enters it, and the shaft is then filled in with earth. Rági thus stored will keep for an indefinite number of years. It is safe from insects and rats, and is not easily accessible to thieves, as the pits are generally situated near the village,—sometimes in the streets,—and it takes some little time to dig to the grain. Moreover, it is highly dangerous to enter a rági-pit till twelve hours or more after it has been opened. The carbonic acid gas generated therein is instantaneously fatal, and, though natives are well aware of this, accidents frequently happen."

The following account of the rock-granaries of Peru and Bolivia is given me by my cousin, Mr. J. J. Winder, who has been for more than twenty years a resident in South America, chiefly at Tupiza, in Bolivia. He says:—"There are very many of them throughout the whole of the high table-land of Bolivia and Peru; there may be some in other places, but I do not remember having seen any. Generally they are small in size, are in granite or porphyry, and each belongs exclusively to one family. In one place, however, a storehouse of large

size exists. It is on the road between Ayacucho and Huancavelica, in Peru, and is called 'Rumi-Huasi' (Quechua for stone-house). A porphyritic rock forms a high cliff on the roadside, and out of it has been carved a very large storehouse, about 60 ft. by 30 ft., and 6 to 7 ft. high, as nearly as I can recollect. It is used by the villagers there, a community of some thirty families, for storing wheat, barley, maize, potatoes, &c. Each family keeps its stock separate by means of the limits indicated by niches or shallow arches carved around the sides. The entrance to this store is a hole about four feet square in the face of the cliff, which is kept closed by a stone exactly fitting the opening. The Indians say it was a storehouse of the Incas, but whether this is true or not I cannot say. The smaller store-holes vary very much in shape. They are made in retired spots, in any rock that may be convenient. They are all more or less old—at least the Indians say they were excavated by the 'Gentiles,' as they call their forefathers who existed before the Spanish Conquest. The people using them are the civilised communities of Quechua and Aymara Indians. I do not think they were ever dwellings, but that they have always been used as storehouses. The Indians generally store their grain-crops in straw and ear. When they have any stock of grain or flour, they keep it in earthen pots within the granary. Many of these pots are of very large size, as large as the entrance will allow them to be. The shape of the entrance varies, but the stone by which the entrance is closed always fits accurately, so that the position of the store is by no means obvious to the casual passer-by. I had ridden many times past the great store mentioned without having suspected its existence, till I one day passed when the entrance-stone had been rolled back."

Appendix III.

Ancient British Granaries.

Winklebury.

In the 'Times' of September 1st, 1883, an account is given of the exploration of the ancient camp known as Winklebury, which has recently been examined by Maj.-Gen. Pitt Rivers. The writer states that one of the most interesting discoveries was that of "a considerable number of pits excavated out of the chalk within the area of the camp. Some of these were as much as four feet in diameter, and upon being cleared out there were turned up, among other things, a fragment of a bone comb, such as must have been used in weaving, and

several chalk weights, with a hole near the top by which to suspend them. These 'finds' were taken as proof positive of an occupation as far back as 300 B.C. But, more remarkable still, especially as showing the probable use to which these pits were some of them put, at the bottom of one of them was found a quantity of grains of wheat, barley, and oats—black with age and decay, but still preserving each their well-defined form; and there can exist, therefore, but little doubt that these pits were the storehouses of the inhabitants of the camp. In another of the pits the explorers came across a large stone which had evidently been employed for grinding corn." The Winklebury explored was the camp of that name on the borders of Wiltshire and Dorset, not the Winklebury near Basingstoke.

The Isle of Portland.

A short notice in the 'English Mechanic and World of Science' of the excursion of the Geologists' Association and Essex Field Club to the Deneholes of Hangman's Wood in the summer of 1853 attracted the attention of Mr. A. M. Wallis, a quarryman and fossil-collector living in the Isle of Portland. He thereupon wrote to Dr. Foulerton, Honorary Secretary to the Geologists' Association, describing and sending drawings of some remarkable beehive-shaped excavations recently laid bare during quarry-extensions in Portland. Mr. Wallis's letter having been referred to me at the meeting of the Geologists' Association in December, 1883, I visited the Isle of Portland in March, 1884, in order to see something of these holes, and an account of this visit is given in Proc. Geol. Assoc., vol. viii., Part 7 (July, 1884). No holes of this kind have ever been discovered in Portland previous to the last two years or thereabouts, and they have been found by the quarrymen when removing some fifteen or twenty feet of Purbeck Beds at the surface in order to get at the Portland stone beneath. Those hitherto discovered have all been a little eastward of the road between Yeales and Easton, towards the northern end of the island. These beehive-shaped pits were all walled-in by pieces of the rubble-stone in which they are mainly excavated, and varied considerably in size. The largest chambers were seven or eight feet in height, and about nine feet in diameter at the bottom, the floor being eleven or twelve feet beneath the surface of the ground. The smallest chambers were only about four feet high, and six feet in diameter or thereabouts. The entrance to them was a narrow opening in the middle of the roof, just

large enough to admit a man, and covered by a piece of hard flaggy stone, this stone being placed just below the vegetable soil, which is from one to two feet thick. In one of these holes a considerable amount of blackened corn was found, mixed with black earth, the latter probably marking the total decomposition of a much larger quantity. Three old querns have been found close by the beehive-shaped pits, about twelve or fourteen of the latter having been discovered. The general resemblance of these Portland pits to those of Southern India is very striking.

Of course there are plenty of differences in detail between rock-granaries such as these and Deneholes. Details, however, necessarily vary with the geology of a place. And it is important to note the universal prevalence, now or formerly, of these rock-granaries, whether entered laterally or vertically, whether in gravel, granite, or chalk. They are, besides, necessarily akin to Deneholes in this, that both alike belong to the class consisting of pits excavated for some domestic purpose or purposes, and not for the sake of the material derived from them.

Norfolk.

My friend Mr. H. B. Woodward, of the Geological Survey, has kindly sent me the following account of the discovery of some buried wheat near Lammas, in E. Norfolk. It is given in a letter from Thomas Munro (?) to the late Samuel Woodward, dated 29th Aug., 1834. Mr. Munro thus writes:—"It was discovered on the side of a lane a little to the left of the road leading through Lammas to Buxton, where an acquaintance of mine was allowed to dig sand and gravel for top-dressing an adjacent meadow, and the quantity was not less than eight or ten quarters. . . . . An oak tree of considerable age grew near the spot, the fibrous roots of which had insinuated themselves among the wheat, which lay in two distinct compartments at the bottom of the sloping bank, separated by a natural division running transversely through the pit."

VII.

On a Specimen of a Whale, Rudolphi's Rorqual (Balænoptera borealis, Lesson,—Sibbaldius laticeps, Gray) lately taken in the River Crouch, Essex.

By Prof. W. H. Flower, LL.D., F.R.S., F.L.S., Pres. Z.S., &c.

[Read December 15th, 1883.]

Early in the morning of the 1st of November, 1883, some fishermen discovered a whale alive in shallow water near the mouth of the River Crouch, in Essex, having had its retreat to the open sea cut off by the falling tide. After considerable difficulty they succeeded in capturing and killing it. It was exhibited for some time at Southend, and was the subject of a Chancery suit regarding its ownership between the Lord of the Manor of Burnham, Sir Henry Mildmay, and the fishermen who caught it, the former establishing his claim to it as a "royal fish." The following is the report of the motion as it appeared in the 'Times' of Thursday, Nov. 8th, 1883:—

"High Court of Justice. Before Mr. Justice Chitty. *Mildmay* v. *Page*.—The Plaintiff, Sir Henry Mildmay, lord of the manor of Burnham, in the County of Essex, claims to be entitled to a several fishery in the River Crouch, and to all royal fish caught in the river. A Whale of a somewhat uncommon species, called a Rock Whale [Rorqual ?] was recently captured in the river by the defendant, who is now exhibiting it at Southend, and the plaintiff asserts that it belongs to him as lord of the manor.

"Mr. Methold now applied for an *interim* injunction to restrain the defendant from parting with, injuring or destroying the Whale, on the ground that it was a royal fish, and he stated, in support of his application, that the plaintiff's predecessor in title had obtained the verdict of a jury in 1673 affirming the title of the lord to the several fishery, and,

further that the court rolls contained evidence of presentments made in respect of Porpoises.

"His lordship granted an *interim* injunction over next Friday, in the terms above stated."

The Whale was ultimately purchased by Mr. E. P. Ramsay, curator of the Australian Museum, Sydney, and the skeleton, when roughly cleaned by Mr. Gerrard, was removed to London, where I had the opportunity of examining it on the 17th of November, and of determining the species to which it belonged, which had hitherto been a matter of doubt, though it had been generally supposed to be a young example of the Common Rorqual (*Balænoptera musculus*). The animal was a male, and Mr. J. T. Carrington, who saw it within two days of its capture, describes the colour of its back as a rich glossy black which shaded to a brilliant white on the under parts, the flippers being black. Unfortunately, no accurate drawing or more detailed description of its external characters appears to have been taken.[1]

The skull measured 6 feet 2 inches in length, and the complete vertebral column 22 feet 3 inches, giving 28 feet 5 inches in length from the apex of the rostrum to the end of the last caudal vertebra, in a straight line, all the intravertebral substances being preserved. The length of the animal in the flesh may therefore be taken at about 29 feet. The condition of the bones showed that it was not adult. There are good grounds for believing that this species, when fully grown, may attain the length of 40 feet, if not more, though there is no specimen of that size at present preserved in any museum. There were seven cervical, thirteen dorsal, fifteen lumbar, and twenty-one caudal vertebræ, making

[1] [Photographs of the Whale were taken by Mr. E. Lawton, of Southend, and a set of them, presented by Mr. R. Meldola, is now in the library of the Club. The photographs have been shown to Prof. Flower, who remarks upon them: "They show some points in the exterior of the Whale of interest, but, owing to the distorted position of the subject, together with the foreshortening and absence of view of the side and back, it would not be possible to construct from them a zoologically accurate figure of the complete animal."—Ed.]

fifty-six in all. The upper end of the first rib on both sides appeared deeply cleft in two, an appearance occasioned by the presence of a short cervical rib, firmly united to it, as in the case of nearly all the other skeletons of this species hitherto observed. Some further osteological details will be found in a notice of the specimen given in the 'Proceedings of the Zoological Society' for November 20th, 1883.

The whalebone or baleen was fortunately preserved with the skeleton. The outer edge and greater part of each blade is black; but the inner edge and the hairy fringe is almost pure white, and at the posterior end of the series the colour of the entire blades gradually changes from black to almost pure white. The longest blades at the middle of the series are exactly twelve inches in length on the outer edge, to which almost an inch may be added for the hairy fringe. To count the blades accurately is a matter of great difficulty, as they gradually degenerate at the extremities of the series, especially in front, into little more than bristles; but 300 on each side may be taken as a close approximation.

Of the four species of Rorquals known to inhabit the North Atlantic, viz., *B. sibbaldii*, *B. musculus*, *B. borealis*, and *B. rostrata* (giving them in the order of size), *B. borealis* appears to be the least common, and the one of the captures of which there are the fewest recorded examples, especially on our coasts. In the seas around Norway it is, however, said not to be infrequent. The following cases of the occurrence of stranded or captured individuals will supply all that is at present known of its geographical distribution:—

Norwegian Coast.

1. North Cape. Skeleton in the Brussels Museum.
2. Loffoden Islands. Skeleton in the Bergen Museum.
3. Near Bergen. Skeleton in the Bergen Museum, Holstein.
4. Near Grömitz, in 1819. Skeleton in the Berlin Museum. Described by Rudolphi.

Holland.

5. Near Monniken Dam in the Zuider Zee, in 1811. Skeleton in the Leyden Museum.

France.

6. Near Biarritz, in 1874. Skeleton in the Bayonne Museum.

Great Britain.

7. Near Bo'ness in the Firth of Forth, in 1872. Skeleton in the University of Edinburgh Museum.

8. River Crouch, Essex, in 1883.

To these may be added the doubtful case of the whale stranded at Charmouth, Dorsetshire, 1840, the skeleton of which was unfortunately not preserved; and also one taken on the coast of Virginia, North America, in 1858, of which the skeleton is in the Museum of the Academy of Natural Sciences at Philadelphia, and is believed by Cope to belong to this species.

The synonomy of this species, as in the case of most other whales, is involved in considerable confusion. The generic name must be determined by the question, which is open to considerable difference of opinion, as to how far it is expedient to multiply such divisions. *Balæna*, *Balænoptera*, *Sibbaldius* and *Rudolphius*, which have been applied to this animal at various successive times, indicate various stages of subdivision of the Linnean genus at the head of the list. Of the propriety of separating the Rorquals or Fin-whales (genus *Balænoptera* of Lacèpède) from the Right Whales (to which *Balæna* is now restricted) there can be no question; but with the further subdivision of *Balænoptera* I am not at present disposed to concur, and would therefore prefer to retain the present species under that name, although there is certainly something to be said for Dr. Gray's first division of the group into three, which he called respectively *Physalus*, *Sibbaldius*, and *Balænoptera*.

With regard to the specific name, that of *rostrata*, under which the species was first introduced to scientific notice in the description given by Rudolphi of the Holstein specimen (Abhandl. Akad., Berlin, 1820, p. 27) cannot be maintained, as it arose from an erroneous identification with the totally distinct species which had already received that name. Cuvier used the term "Rorqual du Nord" for a

species of which Rudolphi's specimen was the type, and this was translated into Latin by Lesson, as *Balænoptera borealis*, in his 'Histoire Naturelle des Cètacés,' p. 342 (1828). Although there was afterwards a confusion between this species and the larger one now known as *B. sibbaldii*, and the name *borealis* sometimes applied to the latter, of its first application to this species there can be no doubt, as it has distinct priority over Gray's name *laticeps* ('Zoology of the Voyage of the Erebus and Terror,' 1846), also founded on Rudolphi's description, and which is moreover very inappropriate, as the head is not wider proportionately than in other members of the genus.

Postscript.—The delay in the publication of this paper has enabled me to add, that in the month of September, 1884, a whale of the same species, and about the same size, was caught near Goole, in the River Humber. The skeleton is being prepared for the collection of Cetacea in the British Museum.

VIII.

Local Scientific Societies, and the Minor Pre-historic Remains of Britain.[1]

By Raphael Meldola, F.R.A.S., F.C.S., M.A.I., &c.

[Read before the British Association for the Advancement of Science, at Southport, and (in substance) before the Club, November 24th, 1883].

In the annual address which I had the pleasure of delivering to the Essex Field Club at the beginning of this year,[2] I ventured to put forward a suggestion which I will take the present opportunity of enlarging upon in the presence of this gathering of the representatives of so many of the local societies of this country.

Of the various branches of natural science cultivated by our respective societies perhaps no subject possesses so widespread an interest as the early history of man. It is only in recent times that materials have been gathered with anything like scientific method from the fragmentary records of the past. By the methods of modern research these materials have been co-ordinated into that imperfect sketch of the physical characters and mode of life of the early inhabitants of this and other countries which constitutes our present

[1] [This paper was prepared by Mr. Meldola, for the Conference of Delegates from Local Societies, which he attended as representing the Club and the Braintree and Bocking Natural History Society. We print it here for the purpose of giving our members a concise exposition of the considerations which have induced the Council to undertake the task of cataloguing the Pre-historic remains in Essex. A committee has been formed, and a considerable amount of preliminary literary research accomplished. The work will be pushed on vigorously as soon as the Denehole explorations, now in hand, are completed. Meanwhile the Secretary will be very glad to receive details of earthworks now existing, and suggestions as to sources of information, &c., from anyone willing to help forward the undertaking.—Ed.]

[2] 'Transactions,' vol. iii., p. 62.

knowledge of prehistoric archæology. But vast as have been the strides in this department of knowledge within the last quarter-century, it is certain that even now we are only on the threshold of a dim region into which advance is becoming more and more difficult with the increasing scantiness of the evidence the further we penetrate backwards into the history of our race. The labours of cave-hunters and searchers into our ancient river gravels—the excavators of our earthworks and tumuli—have garnered a rich harvest of facts upon which is based the existing knowledge of ancient man. The old method of solving problems in prehistoric archæology by attaching a tradition to any ancient monument of which the history was unknown, has been weighed in the balance and found wanting. The erudite verbiage of the old-school antiquarian has been displaced by the shovel and pick of the modern investigator.

While the spirit of scientific enquiry is thus gradually enabling us to reconstruct some few chapters of the past history of man from such remains as have been preserved to us, the extreme importance of the relics themselves is as a natural consequence becoming more and more recognized. It must have been with the greatest satisfaction that anthropologists heard that the ancient monuments of this country, thanks to the foresight of Sir John Lubbock, were to receive Government protection. For years past the destruction of the most venerable relics has been going on, partly through local ignorance of their value, partly through wilfulness, and partly through the unavoidable clearance of ground for building and agricultural purposes. But although the larger and better-known remains are now secured from demolition, there are numerous smaller and less-known relics scattered over the country, which in the course of time are doomed to destruction by the advancing tide of civilisation. As may be seen on reference to good topographical works, the irreparable losses which anthropological science has already incurred in this way are enormous. The most deplorable feature in these cases of destruction is that they have occurred without adequate scientific supervision, and any

evidence that might have been gathered by competent watchers has been for ever lost.

The systematic excavation of earthworks, barrows, tumuli, &c., by the method of exploration, is necessarily expensive work, and it is to me a matter of some surprise that the munificent example set by men like General Pitt-Rivers and Canon Greenwell, has not been more widely followed by those who, with the knowledge of this difficulty, have it within their means to promote this branch of research. As in the case of one of the societies which I have the honour of representing (the Essex Field Club), which at the instigation of General Pitt-Rivers, undertook the investigation of the ancient earthworks in Epping Forest, good work can sometimes be done by a local society, by raising a fund for the purpose of exploring such remains in its own district, and this leads me to the immediate object of the present paper.

In attempting to draw up any suggestions for the guidance of local societies, the great difficulty appears to be the impossibility of finding any subjects for research of a sufficiently general scope to be open to all societies. The subjects already proposed by the committee appointed last year by the conference of delegates are, as you are aware: (1) underground waters, (2) erratic blocks, (3) underground temperature, (4) rainfall, (5) periodical natural phenomena, (6) injurious insects. To these I am now about to suggest the addition of another subject, *viz.* (7) prehistoric remains. Here, as it seems to me, there is a useful field for co-operation among the societies of all counties. Thanks to the increasing interest in scientific matters now making itself felt throughout the country, there is perhaps no corner of Britain which does not or could not be made to fall into the province of some local society or field club. In view of the imminent destruction of many of the minor remains on the one hand, and the scheduling of the larger remains for State protection on the other hand, I believe that occupation of the greatest importance exists for all local societies.

The time has perhaps not yet arrived for laying down any rigid system for dealing with the proposed subject, and I

therefore think it advisable at present to confine myself to a few general observations respecting the nature of the work which it is desirable that local societies should take in hand. It must be understood that these remarks are limited to prehistoric archæology, as the remains belonging to the historical period are generally dealt with by archæological societies, and do not come within the range of science subjects admitted by the British Association.

Assuming then that all societies have prehistoric remains of some kind within their districts, the first and most essential thing to be done is to draw up catalogues of these relics, giving their position, external form and structure, and bibliographical references. If the societies of each county would undertake this task, arranging matters so that no relic, however apparently insignificant, escaped their vigilance, we should thus in time come to possess a complete catalogue of the ancient remains of Britain, and at the same time we should gradually get together a most valuable collection of literary references. The bibliography is essential, because so many of our ancient remains have from time to time been investigated and the results buried in some obscure archæological paper, the disinterment of which is in itself a piece of antiquarian research. A catalogue such as the one now proposed would thus serve many useful purposes. We should have an index-guide indicating precisely where prehistoric remains exist at the present time, and further whether they had ever been systematically explored, and if so, with what results. At the same time attention would be directed to many relics which the local society and the Government inspector might deem worthy of being scheduled for State protection. By this means I am disposed to believe that the operation of the Ancient Monuments Bill would be considerably accelerated, and its effectiveness thereby increased.

It will be as yet premature to suggest any general form in which the proposed catalogue should be cast. Each society would no doubt at first work upon a plan of its own. But whatever form be adopted, it is advisable that publicity should be given to the results in the Transactions or Proceedings of

the respective societies, as the purely local interest in the work would be thus greatly enhanced, and the working up of the whole into one compendious catalogue might possibly be done later by a committee of the British Association, composed partly of delegates from local corresponding societies, and partly of other eminent authorities in prehistoric archæology whose assistance and advice it would be most desirable to secure.

If the scheme now broached should be deemed worthy of consideration by your respective societies, it would be essential, in order to carry out the work effectively, to appoint from your councils and members ancient monument committees, whose function it would be to draw up the proposed catalogue, visiting the remains to be entered in all cases where possible, and exhausting topographical literature and tradition in order to avoid including any fictitious remains. Where no literary references are to be found, and in cases where doubtful structures exist, it would be all the more advisable to enter these in the catalogue, with appropriate remarks, so that systematic explorations might be made when the opportunity presented itself for raising a fund for the purpose. Even when local histories or traditions are decided respecting the age of any earthwork or other ancient structure, but little credence can be attached to such traditions until actual investigations have been made. As far as my own experience goes, and from information derived from other sources, it would appear that local tradition is the bane of the scientific archæologist. There is, for instance, hardly any prehistoric monument in this country that has not been pronounced "Roman" by some antiquarian authority, an opinion which not only has often been proved by excavation to be erroneous, but which has also had the pernicious effect of checking further inquiry.

In recommending to your societies the actual investigation of the minor prehistoric remains of your district as a task well worthy of the attention of any scientific body, it is perhaps not wholly necessary to urge that any excavations attempted should be carried out with the most scrupulous

care, and the materials removed restored if possible on the completion of the work, so as to avoid any permanent disfigurement. The so-called "exploration" of many ancient structures, whose venerable antiquity should have rendered them sacred, has often been conducted in a manner which can only be called an act of desecration. How frequently do we read in local histories such statements as the following:— "On —— Common there formerly stood a large mound of earth supposed to be a tumulus, which was opened by Mr. —— in the year ——, but nothing of any interest was found, *except a few fragments of pottery and some decayed bones*"! Such passages as this, which is not a verbatim extract, but simply an ideal specimen illustrating the kind of destruction that has been going on, lead to the supposition that the prevailing idea in opening a tumulus is the discovery of hidden treasure. Any other find is considered devoid of interest, and the scientific value of the structure is for ever lost by the scattering of its contents.

The ancient monument committees of local societies, in addition to the preparation of catalogues and the conducting of explorations, would have another important function to fulfil; they might take upon themselves the duties of vigilance committees, keeping a watchful eye upon the ancient remains in their neighbourhood, and preventing as far as possible their destruction. In the case of minor remains which were not considered worth scheduling for State protection, opportunities would often occur for investigating without incurring the expense of systematic excavations. In the course of building or agricultural operations, old ramparts are frequently cleared away in perfect ignorance of their value to the archæologist: or again, a new road has to be made, which in its course passes through the remains of some ancient earthwork, now almost obliterated by the hand of of time. In such cases the vigilance committee, having previously catalogued the remains threatened, would endeavour to come to some arrangement with the owner of the property, and obtain permission to appoint watchers, for the purpose of recording the nature and position of any relics that might be

found. The fact that local societies have not in past times been sufficiently alive to the important work which might thus have been done, by taking advantage of any unavoidable demolition of prehistoric remains, has led to the destruction of a vast amount of material which, under proper supervision, might have furnished facts of lasting importance to anthropological science. It remains with your respective societies to determine whether such ruthless waste of evidence is to be allowed in the future.

[The principal items of information requested to be furnished to the Ancient Remains Committee of the Essex Field Club by local residents and antiquaries generally, are:—(1) The situation of the remains with respect to the nearest town or village, and whether entered on any published map. (2) Supposed origin or period of construction, and whether any tradition or belief is current in the neighbourhood with respect to the earthwork or other remains. (3) Whether ever explored; if so, by whom; with references to published or unpublished records of the explorations, and present place of deposit or owner of any relics discovered. (4) Account of any remains that have been demolished in the neighbourhood, with dates and references. (5) Full bibliographical references to works giving information respecting the remains in Essex, and to other sources of information both general and local. —Ed.]

IX.

The Use of the Hygro-Spectroscope (or Rain-band Spectroscope) in Meteorology.

By F. W. Cory, M.R.C.S., F.R.Met.S., &c.

[Read November 24th, 1883.]

[Before proceeding to the main subject of his paper, Mr. Cory gave an explanation of the well-known property of the prism, by which it is enabled to split up a beam of light into the component coloured rays which form white light, the resulting band being termed a spectrum. He also demonstrated, by diagrams, the fact that the *violet* rays are most bent out of the straight course (or refracted), and the *red* the least so, these colours forming the extremes of the tinted band or spectrum visible to human eyes. He then showed the effect of allowing the light to flow through a *slit* in a metal plate, whereby the image of the slit is repeated very many times (owing to the different refrangibilities of the component

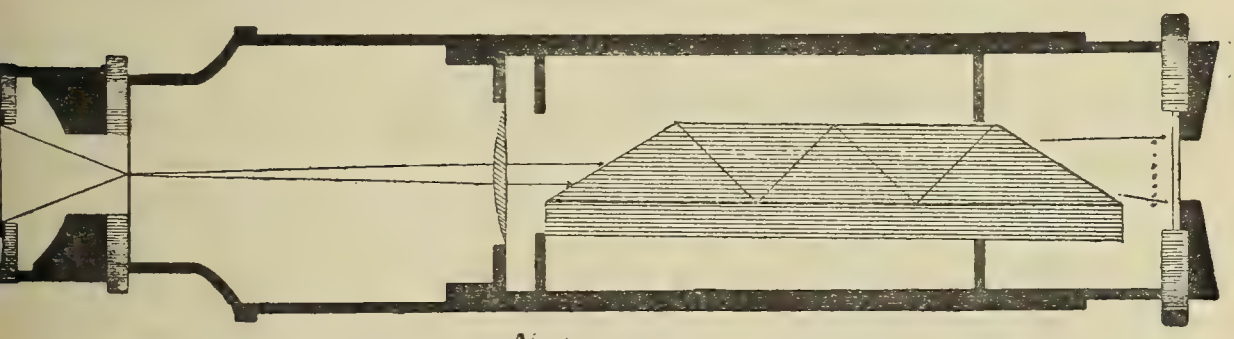


Fig. 1.—Section of Rain-band Spectroscope, size of original, the eye-piece being on the right-hand side of the spectator.

parts of a ray of white light), and a coloured band is formed, each kind of light always occupying a certain relative position in the spectrum. He showed that the dark lines ("Fraunhofer's lines") which are then seen in various parts of the spectrum are due to the absorption or shutting-off of certain rays of light by various vapours in the sun's atmosphere (solar lines) or in our own (telluric lines), and consequent absence of any image of the slit in those particular positions; the result being that dark lines of greater or less intensity are seen crossing the spectrum. The application of these facts to the construction of the direct-vision spectroscope was then explained, and at Fig. 1 is a drawing showing a section

of the instrument used by the author. This spectroscope contains a battery of five prisms: 1, 3, and 5 are made of crown-glass, and 2 and 4 of flint-glass. It is found that by this arrangement a greater dispersion of the coloured rays is produced, and consequently a better view of the dark, or "Fraunhofer's," lines obtained. The prisms are contained in a cylinder of brass, which slides in another tube to allow of adjustment, and the slit, stops, and various other adjuncts make up an instrument called the "Direct-vision Spectroscope." The course of the rays of light is shown by the converging, diverging, parallel and again diverging lines. The light entering the end of the instrument has to pass through a flat piece of microscopical glass to a slit which is adjustable to as fine a degree as is necessary by means of the milled wheel outside (Fig. 2). The rays forming the image

Fig. 2.—Grace's Spectroscope, as made by Mr. Browning, about two-thirds actual size.

of the slit are rendered parallel by passing through the plano-convex lens; these again travel through the prisms, and are split up into the various colours forming the prismatic spectrum, an extended view being visible when the eye is placed at the opening at the other end of the instrument. In the more perfect forms of Grace's Hygro-spectroscopes an adjustable photographic micrometer, with prism of comparison, is fitted to the outside of the instrument.—Ed.]

The use of the spectroscope in the study of the weather is of comparatively recent date. At the present time it is not yet generally recognised by scientific men as an addition worthy to be placed amongst the instruments forming the equipment of the meteorologist, but happily, I am pleased to state, the evidence in favour of it has considerably augmented during the last twelve months; in fact I am almost daily receiving testimony from various sources that something must be expected from the analysis of daylight as an aid in forecasting weather, and that the indications of the hygro-

spectroscope are to be depended upon, even when the rain-band alone is taken into account in making an observation. What is the rain-band? and where is it situated in the spectrum?

The principal rain-band, for there are others which I will refer to subsequently, is situated on the red side of the D lines, involving them, and at times increasing or decreasing in intensity, according to the nearness or quantity of rain. In spectroscopes of small dispersion it exhibits itself as a dark shading; in larger instruments this band will be split up into a quantity of fine black lines, which are due to the absence of rays of light of certain refrangibilities.

It would be as well now to take you back to the time when physicists first became sensible of varying lines in the spectrum, due to the presence in the air of vapour of certain densities, and of peculiar states of equilibrium. To quote from Mr. Capron's excellent little pamphlet, 'A Plea for the Rain-band'[1]:—

"Its history may be said to date from the time when Ångström's maps of the solar lines were found to present different aspects, according to the condition of moisture of the atmosphere at the time of observation, and when that pioneer of spectroscopy proved the presence and absence of certain lines forming bands in the spectrum, more especially a set near D, to depend on that condition. No practical meteorological result followed, however, until, as Prof. Piazzi Smyth tells us, the subject was first presented to him as a marked feature in sky spectrum at Palermo before and after a sirocco in 1872. Next, when in July, 1875, destructive

[1] I may be permitted to make a few remarks as to the origin of the word "Hygro-spectroscope." A short time since it occurred to me that the name "Rain-band Spectroscope" was a decided misnomer, as there are other moisture-bands of equal importance besides the rain-band. The instrument is essentially a hygroscope or hygrometer (*i. e.*, an apparatus for seeing or measuring moisture) combined with a spectroscope. With these reasons in view, I was led to coin the word Hygro-spectroscope (ὑγρὸς, moist, *spectrum;* and σκοπεω, to spy), which compound is more applicable to the necessities of the case, and, what is very satisfactory, has gained the approval of several scientific men of high standing.

floods in both France and England (*not predicted by the barometer*) were noticed by him in connection with a peculiar band in the spectrum under dates July 19th and 26th, 1875. Prof. Smyth vividly described in 'Nature' (vol. xii., pp. 231, 252) the phenomena then observed, how the dark band near D was found the forecast of a drenching afternoon following the fine opening of a Scotch holiday in Edinburgh; and how, on another occasion, it became the 'spectroscopic *prévision* of rain with a high barometer.' Then followed observations in May, 1876, to the same effect in France, especially at Marseilles, where the rain-band was seen in the spectrum, and followed by rain, to the surprise of the natives, who consulted only the public barometer and thermometer, and found none predicted. In February, 1878, appeared the fourteenth volume of the 'Edinburgh Astronomical Observations' (1870–1877), and here, under the head of 'Meteorological spectroscopy in the small and rough,' we have the subject treated in a most complete and elaborate manner, and illustrated by a set of engravings of spectra. The Scottish Meteorological Society's 'Journal' (N. S., Nos. 51, 52) also contains contributions by Prof. Smyth on the subject. Again, in 'Nature' of July 1st, 1880 (vol. xxii., pp. 194–5), the subject of 'rain-band spectroscopy' is dealt with in a condensed and epitomised form very acceptable to the reader, who doubtless will recognise the identity of the 'Edinburgh Experimenter' in this useful contribution on the subject."

It will at once be seen from the above that Prof. Piazzi Smyth, the talented and kindly Astronomer-Royal for Scotland, was the real discoverer of the "rain-band," but I consider that a great deal of praise is due to Mr. Rand Capron for popularising the subject by means of the before-mentioned monograph. In June of this year I was induced, from some letters that I had communicated to the 'Times,' to read a paper on this topic before the Royal Meteorological Society.[2] I endeavoured to show in this—1st, that the rain-band is not the only feature to take into account in the sky spectrum; 2nd, that to successfully forecast rain the spectroscope ought to be directed towards that quarter from which the wind is

[2] [Since published (Quart. Journ. Meteor. Soc., vol. ix. (No. 48), p. 234), under the title, "The Spectroscope as an Aid in Forecasting Weather." Ed.]

blowing or likely to change to. Since this matter was suggested it has been adopted by observers and found to work very satisfactorily, especially if the results are charted, in order that the increasing or decreasing percentages, &c., may be studied, and calculations made accordingly; 3rd, that some attention ought to be paid to the varying tints and depth of colour in the prismatic spectrum, the differences at times being very remarkable; 4th, that, as a rule, several days before snow, the rain-band diminished considerably, the spectrum became clearer, and the calcium and barium lines on the blue side of D were unusually prominent.

Amongst hygro-spectroscopists at one time it was thought that the observer with the help of *the rain-band* ought to be able to prognosticate almost every form of precipitation; this was too much to be expected of one feature in the spectrum. The principal rain-band on the red side of D does not indicate the deposition of dew, neither the fall of solid bodies such as hail or even snow, which last, as I have just remarked, must only be expected from negative results as regards the rain-band. Thunderstorms are almost invariably accompanied by hail; and Mr. Bramley Moore, of Liverpool, has pointed out in 'Knowledge' that the most noticeable phenomenon in the sky spectrum, before their occurrence, is the extreme depth in colour of the blue, and an unusual prominence of the green, which he describes as apparently overlapping the blue. I cannot say that my experience of the unquestionable difference in colour is such as to justify my describing it as the one "overlapping" the other. To these I would add, the dark band at V, which is generally most marked before heavy rain, and more or less percentage of the principal rain-band, according to the amount of rain accompanying the storm. I well recollect one instance in which all these features were so extremely well marked at the time of observation, about 10 a.m., that I confidently prophesied a storm would take place, although none of the other instruments, nor any particular aspect of the sky, nor high temperature with oppressiveness, indicated that such an aërial disturbance was about to occur, yet, certain enough, in

the evening, about 7 o'clock, the storm did come, much to the astonishment of a great many, including the friends with whom I was staying.

It must be remembered that the spectroscope is quite independent of any threatening appearance of clouds, or the opposite; frequently in the former case it will tell you—no precipitation will occur; and in the latter we must expect some before long. I will now advert to the dry and moist air-bands, and principal constant solar lines, the position of which I have delineated on the chart of the spectrum (Fig. 3).

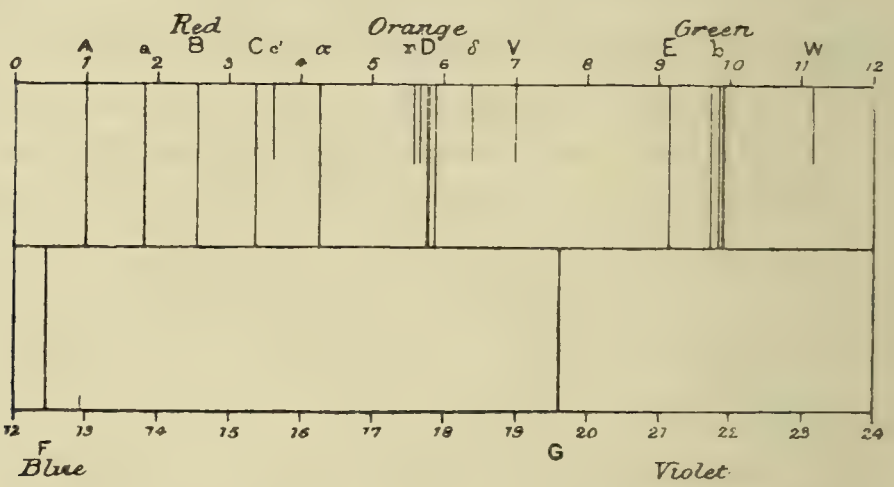


Fig. 3. — In the above chart the relative positions of the permanent lines and bands of the spectrum are represented, but not their actual appearances as seen in a spectroscope. (*From want of space the chart has been cut in two, and the second half placed below the first*). The principal rain-band is figured by means of the two lines to the red side of D; with greater dispersion these are split up into numerous lines of varying intensities. To the blue side of D is shown the position of the line that is unusually prominent and defined previous to the falling of snow, when this part of the spectrum is partly, if not wholly, cleared from vapour-lines. The instrument used in the construction of this diagram was a Grace's spectroscope, with attached micrometer.

Commencing at the red end we have first A; in spectroscopes of moderate dispersion this permanent line is seldom seen, unless the spectrum at this part is unusually clear; meteorologically speaking, I have not found it of much value.

At a is the position of a moist air- or rain-band, and at B a dry air-band; these three, A, a, and B, are best studied by looking direct at the sun. The band at C is probably due to water vapour. At *c′* is a small rain-band.

Passing on now to the dry air-band at α, which, if intense, prognosticates a fine and dry period, extending from a few days to even weeks, Prof. Smyth chronicles an instance, in vol. xiv. of the 'Edinburgh Astronomical Observations,' where an unusual darkness of this band was accompanied by very dry weather over the whole of Europe. On the other hand, a very low percentage of it must not be taken as a sign of rain: it simply denotes moisture, which may not be deposited as rain.

Next in order is the principal rain-band at *r*, already partly referred to at the commencement of this paper; this has had more attention paid to it than any other part of the spectrum: it is most conspicuous when well marked; and one can say with absolute certainty, should 80 per cent. be shown, rain will decidedly fall before long; and if 20 per cent. only be visible, none will occur for at least six hours. At δ is a low sun-band. v I have already remarked upon. E and *b* are constant solar lines, which will be found useful in focussing the spectroscope. At w is a moisture-band that is seldom seen. The hydrogen line, F, is sometimes almost invisible when the blue is very deep: this occurs more or less before heavy rain; but should it stand out clear and distinct in the blue, which in such a case is lighter in tint, then fine weather with or without wind will follow.

As regards the best hours for observing, 9 a.m. and 3 p.m. will be found the most suitable. An observer when using the spectroscope should be careful to shade the eyes in such a way that all extraneous light may be excluded as much as possible, and to adjust the focus and slit so that the lines may be of the clearest definition. Elevate the instrument about 13 degrees, and put down on a chart the percentage of the principal rain-band for 8 points of the compass, then direct it to the zenith; observe the other features in the spectrum, especially any difference in tint of the colours: this ought to be attended to first, as they will be found to change somewhat after a time. Enter all these particulars in a note-book, in order that they may be referred to at some future time. By attending to these simple directions, with a

few months' practice, the observer will meet with success; but he must not expect it to be unlimited, although the spectroscope is more to be relied on, and far in advance of any other means of presaging rain. For cases occur sometimes in which a high percentage of rain-band has led him to predict rain, yet that rain did not occur in his immediate vicinity, but passed—as I have already proved in numerous cases—to one or other side of him; in some few instances the rain-cloud has deposited its shower before passing over his locality. Everybody knows how localised rain is, and to state that such a prophecy as I have adduced has proved incorrect is a most unwarrantable paralogism.

What we really require is a system of well-trained observers in the British Isles; then our daily forecasts in regard to rain will begin to show signs of improvement. They sadly want it, however. For something surely must be expected from an instrument of such marvellous telescopic power that can detect a rain-cloud in certain conditions of the atmosphere, 100 miles off, or even more; and that can partly inform you of the chemical composition of stars at the distance of billions and billions of miles.

I would urge all those who take an interest in this fascinating branch of Dioptrics to use their best endeavours to promote the adoption of the hygro-spectroscope, particularly amongst farmers and others whose interests are affected by the weather; but also, if possible, to influence "the powers that be" to further the adoption of an invaluable instrument that may be the means of saving the country annually thousands of pounds.

[Those desiring further information as to the practical employment of the instrument may be referred to Mr. Cory's interesting little book, 'How to Foretell the Weather with the Pocket Spectroscope' (London, Chatto & Windus, 1884), in which are reprinted the letters to the 'Times' noticed above.—Ed.]

X.

Some Additional Notes on Essex Watersheds.[1]

By Prof. G. S. Boulger, F.L.S., F.G.S., F.R.G.S., &c.

[Read December 15th, 1883.]

Of the numerous practical applications of the exact observations of Science few are of more universally recognised importance than those bearing on the question of water-supply. Without referring to the limitless waters of the ocean that wash the eastern shores of our county and may soon be utilised as a tidal motive force of matchless power and economy, we have in our county rainfall and its natural and artificial distribution, a topic of general concern. The rainfall of Essex averages about 22 inches per annum, though locally, as at Epping, it exceeds 25 inches. It is estimated that the greater part of this is returned to the air by evaporation to fall again; and, from the small general slope, cold impervious soils, and proximity to the sea, the rate of evaporation in Essex is probably comparatively high. Similarly, while the general ratio of the outfall of rivers to rainfall is either as one to three or four, in the stiff clays and loams of Essex it is probably the first rather than the second, the amount soaking into the ground being relatively small. The chalk districts round Walden and Purfleet are exceptional in this respect in the extent to which their drainage is subterranean; in other parts of the county streams are numerous, but small, depending upon surface drainage rather than upon large or deep-seated springs. More than a quarter of the county drains into the Thames, either directly or through its tributaries, of which the chief are the Lea, the Roding,

[1] [Supplemental to the paper "On the River Basins of Essex as Natural History Provinces," Trans. E. F. C., vol. ii. pp. 79-87.—Ed.]

the Pym, and the Mardyke. With the exception of a small area in the north-west, drained by the Cam into the Wash, the remainder of the 1648 square miles of Essex is drained by streams running eastward, of which the Crouch, the Blackwater, the Colne, and the Stour are the chief. Of these the Blackwater drains the largest area, the portion of the valley of the Stour in Essex being but a narrow strip of country. Though there is no doubt that in prehistoric times these eastern streams, like the Thames itself, formed tributaries of the Rhine, which then flowed down the centre of the German Ocean, a study of the sand-banks of our south-east coast shows the Crouch to belong rather to the Blackwater system than to the Thames.

The watersheds of river valleys form the most obvious natural division of any area, and as such are now commonly adopted by naturalists in subdividing a county for the study of the distribution of plants and animals. For convenience of reference I have ('Transactions of the Essex Field Club,' vol. ii., p. 80) numbered the river basins of Essex as follows:—1, the Lea and Stort; 2, the Roding; 3, the Crouch; 4, the Blackwater: 5, the Colne: 6, the Stour; 7, the Cam; and the object of the following notes is to give some additional particulars and corrections which have suggested themselves since my former paper was printed.

The source of the Lea is in Leagrave Marsh, near Dunstable; and this river drains two-thirds of Hertfordshire. Among its tributaries, the Nasing Brook, entering below Broxbourne, and the Ching, above Walthamstow, from the Forest, were not previously mentioned. Its watershed is south of the church at Henham-on-the-Hill; a line from here to the west of Chickney and Broxted, east of Elsenham and west of East-end Wood, divides the Stort valley from that of the Chelmer; and the former is then separated from that of the Roding by a line passing between Colchester Hall and Lever's Farm to Warish Hall and Takeley Railway-station, east of Barrington Hall and Hatfield Broad Oak, west of Manning Farm and White Roding, to the south-east of Little Laver, between Household Tye and Holt's Green to

Potter Street and Rye-hill Common, thence southward to Epping Union, and then almost along the line of the New Road, but crossing Ambresbury Banks and round to the west of the head of the Wake Valley Pond and of Warner's Pond, Woodford, down Gilbert's Slade to Forest Lodge, west of Leytonstone Station, to Forest Gate Station, North End, to East Ham Station and over East Ham Levels to North Woolwich.

Contrary to what is stated in my former paper (Trans. ii. p. 81), the Ingrebourne originates in several streamlets between South Weald and Navestock, which uniting flow to the west of Upminster and Rainham into Erith Reach. A smaller stream flows from Stubbers, between North and South Ockendon, into the Thames below Rainham.

The Mardyke may be said to rise in Thorndon Park, receiving streams from Dunton Waylett and the northern slope of the Langdon Hills, and being joined at Bulphan by considerable streams from Brentwood and Childerditch, and from Cranham and Great and Little Warley. It then flows past Stifford and Aveley to Purfleet. Other small streams drain the southern slope of the Langdon Hills, partly into the creeks west and north of Canvey Island.

The watershed dividing the Roding and these streams from the Chelmer system, starting from between Elsenham and Tilty, passes to Woodgate and Little Easton, east of Easton Park, between Elms and Hurts to High Roding, east of Aythorp Roding, Leaden Roding, Margaret Roding, Berners Roding, Shellow, Willingale Spain, and Norton Mandeville, west of Fingrith Hall, Blackmore, and Doddinghurst, *but east of Stondon Massey and Navestock, to Bryces*, and not as in map (pl. vi.) to paper in vol. ii. of the 'Transactions,' and east of South Weald and Brentwood Church to the east side of Thorndon Park. This basin is then separated from the valley of the Crouch by a continuation of the same line between East Horndon and Dunton Waylett to Nightingales, south of Vange Hall, north of Pitsea Station and of Bowers Gifford, to Jervis and Hadleigh Castle, north of Leigh and of Snell's Farm, south of Milton Hall and Southchurch, to Shoeburyness.

The watershed between the Crouch and the Chelmer, east of Billericay, passes south of Ramsden Heath and South Hanningfield to Ralphs, east and north-east of East Hanningfield to Flambards, *north of Stow Maries and Latchingdon, but south of Norton Cold and east of Snoreham*, to Althorne.

The Wid is made up of numerous streamlets from Blackmore, Doddinghurst, Shenfield, and Ingrave.

The watershed between the Blackwater and the Cam lies north-east of Henham-on-the-Hill and Debden, to the west of Wimbish, and so to the county boundary north of Cowless Farm; and that between it and the Stour, south-east from this point to the south of Darkens, north of Hempstead, between Rivets and Whitley; and that between it and the Colne passes *north of Mark's Hall*, and from Inworth, Kelvedon Hall and Braxted Park to Tiptree Heath, south of Tiptree House, north of Hill Farm, to Rockingham and Peldon, north of Great Wigborough to the channel separating Mersea Island from the mainland.

The watershed between the valleys of the Colne and the Stour passes from the north of Birdbrook to Ashen, Ovington Wold and Huslins, south of Crouch House, north of Dagworths, east of Pebmarsh and north of Baggerets to Hammit's Farm, then south of Westwood House and of Horkesley Plantation, north of Manor House and south of Langham Moor, north of Dedham, Birch Wood, Stud Hall, Watts and Abbotts Hall, south of Dengewell, Great Oakley and Little Oakley Churches, and of Ramsey.

XI.

Notes on the Geological Position of the Human Skeleton lately found at the Tilbury Docks, Essex.[1]

By T. V. Holmes, F.G.S., M.A.I.

[Read February 23rd, 1884.]

[Owing to the publication of Sir Richard Owen's book,—'Antiquity of Man as deduced from the Discovery of a Human Skeleton during the Excavations of the East and West India Dock-Extension at Tilbury, North Bank of the Thames.' By Sir Richard Owen, K.C.B., F.R.S., &c. London (Van Voorst), [August], 1884,—it is deemed fitting to print this paper somewhat in advance of its order of date.—Ed.]

Most members of the Essex Field Club must have been interested in learning that a human skeleton has lately been found in the Tilbury Dock excavations, and placed in the hands of Sir Richard Owen. On the publication by the Royal Society of Sir Richard Owen's paper [now printed as mentioned above.—Ed.], we shall be in full possession of the anatomical details of this skeleton, which the brief newspaper reports now available show to be a remarkable one. I need hardly say that my own remarks will bear upon the geological interest of the strata in which the Tilbury man was found, and their evidence as to his age, not upon his anatomical peculiarities.

Tilbury Docks are being excavated in the most recent alluvium of the Thames Valley. But as this statement may not in itself suffice to give a clear view of the geological position of the Tilbury skeleton to the non-geologist, a brief

[1] Some additional details obtained since this paper was read are incorporated. The conclusions, however, are unaltered. ee the note at the end for the latest remarks.

account of the nature and formation of alluvial deposits will probably form a useful preface to my other remarks.

If we glance at the map of the Geological Survey, showing the valley of the Thames between London and Gravesend, we see that the Chalk and Tertiary rocks of Kent are separated from those of Essex by a broad band of alluvium or marsh-land, which occupies the ground between the bends of the river. And outside this tract of marsh-land, but still in the neighbourhood of the Thames, we see less continuous patches (of other colours) of gravel and brick-earth, which rest indifferently on Chalk, Thanet Sand, Woolwich Beds, or London Clay, and whose nature, distribution, and fossil contents all testify to their formation by the river at former periods of its existence. These last-named beds are all, however, to be found at various heights above the level of the marsh-land, though the old river-gravel also underlies the marsh alluvium. When a tract of land emerges from the sea, the rain falling upon it tends to form brooks and rivers where slight hollows exist. These hollows gradually become deeper and deeper, from the erosive action of the stream and its tributaries, and should a slow continuous upheaval of the land accompany the deepening of the river-valley by the stream, so as to preserve its angle of slope towards the sea, a river-valley as deep as that of the Grand Cañon of the Colorado may in time be formed. On the other hand, should a subsidence of the area take place, the river, having its fall lessened, soon no longer tends to deepen its valley, but to meander in bold curves and to widen it, forming, as it does so, broad alluvial flats with the material brought down in suspension. And, apart from any subsidence, the natural effect of the deepening of a river-valley by the action of rain and rivers is to bring about, sooner or later, a state of things in which the river can no longer deepen its bed, though it can shift it laterally. Then, as the current impinges on and erodes the bank on one side, deposition of the sand and gravel brought down in the channel of the stream takes place on the opposite shore, where the motion of the water is slight. And in times of flood the surface of the sand and gravel thus

deposited is covered by the mud or silt in suspension in the turbid waters, which fills up the slight hollows and produces the flatness of surface characteristic of alluvium. This deposition is accompanied by a corresponding rise in the bed of the river. The fragments of former alluvial deposits, found as terraces at various heights on the sides of the valleys of the Thames and other rivers, mark the levels at which the stream once flowed, the highest terrace being the oldest. These terraces are the remains of broad continuous sheets of ancient alluvium deposited under much the same circumstances as those in which the lowest flats are now being formed. An upheaval occurring would increase the fall of the river, and cause it to deepen its channel. In doing so it would destroy much of its old alluvial plain, and, sooner or later, cut its way downward to a point at which it would again cease to deepen its bed, and would form another flat at a lower level than the first; and so on.

Tilbury Docks are being made in the newest of the river-deposits of the Thames Valley, the alluvium of the marshes, the deposition of which would still be going on, but for the embankment of the Thames during (or before) the Roman occupation of Britain. An average section of the beds visible (May, 1884) would give:—

Blue Clay	about	7 ft.
Upper Peaty Bed	,,	1 ft.
Blue Clay	,,	11 ft.
Lower Peaty Bed	,,	5 ft.
Blue Clay	,,	7 ft.
Sand, and Gravel		
		31 ft.

But though only two peaty beds were visible in the dock-excavations, we were informed by Mr. J. B. Pinker, the gentleman connected with the works who explained their plan during our excursion in May, that a third and still lower peaty bed had been met with here and there in the trial-borings made within the dock area. This third bed is noted in the account of the section of the New Well at

Tilbury Fort, which is one of those given by Mr. Whitaker in his paper on "Some Essex Wells";[2] it also appears in one of two sections of borings made between Tilbury Docks and Fort. Mr. Whitaker having kindly sent me the details of these new borings, they cannot be given in a better place than this:—

TILBURY. (Trial borings).[3]

(*Communicated by Mr. J. H. Greathead, C.E.*).

No. 1.—WORLD'S END TAVERN.

Soil ...	... ...	2 ft.
Alluvium, 57 ft. 6 in.	Clay	3 ft.
	Mud	20 ft. 6 in.
	Peat	9 ft.
	Mud	7 ft.
	Peat	4 ft.
	Silt	12 ft.
	Peat	2 ft.
Gravel	... ...	1 ft. 6 in.
		61 ft.

No. 2.—BETWEEN THE RAILWAY STATION AND THE WORLD'S END.

Soil ...	... ...	1 ft.
Alluvium, 51 ft. 6 in.	Clay	2 ft. 6 in.
	Mud	12 ft. 6 in.
	Peat	8 ft. 6 in.
	Mud and Silt	28 ft.
Gravel	... ...	0 ft. 6 in.
		53 ft.

Those who took part in the excursion to Tilbury Docks on May 17th, 1884, must have observed the gentle undulations of the beds and the freshness of the vegetable remains. The lower of the two peaty beds visible, when examined, was found to contain the remains of reeds, horse-tails, heather, and other plants, reeds decidedly predominating. A thing

[2] [Read before the Essex Field Club, March 29th, 1884, but not yet published.—ED.]

[3] Mr. Whitaker adds a note—"These were given me in 1883."

generally noticed was the offensive smell of sulphuretted hydrogen proceeding from the plant-remains in this bed, though twenty feet or more below the surface. The preservation of these plants in this slightly decomposed state is of course due to the thick clay beds, both above and below, which have prevented total decay. These beds are simply inundation mud, but their combination with the peaty beds is noteworthy, as it points to periods of subsidence divided by stationary intervals. For the reeds and other plants, the remains of which make up the two peaty beds seen, could not have grown below high-water mark, though the base of the lower of the two beds is now from 20 to 25 feet beneath the surface. The deposit of blue clay above this bed marks a period of subsidence, then the upper peaty bed implies a stationary interval, with a growth of vegetation about or slightly above high-water mark. The blue clay above the upper peaty bed points, of course, to a renewal of the subsidence.

It will have been noticed that, in treating of the evidence of the peaty beds as showing subsidence, I have not mentioned the third and still lower peaty bed, ascertained to exist, here and there, from trial-borings and the Tilbury Fort Well, though not visible on the day of our excursion. But this bed is generally found to rest directly on the sand or gravel, and its composition shows that it probably had an origin different from those of the two others. Instead of consisting of plants that once grew slightly above ordinary high-water mark, it is composed of logs of wood and other vegetable matter that has drifted down the channel and been deposited where the current was sluggish, as it is sure to be on one side of an island in the stream. Capt. Hall (quoted in Lyell's 'Principles') remarks of the islands of the Mississippi that the interval between them and the shore is often found to be "filled up by myriads of logs cemented together by mud and rubbish." And as this lowest peaty bed has probably been formed in this way, it can offer no evidence of subsidence.

No reader of the paper by Prof. W. J. Sollas, "On the Estuaries of the Severn and its Tributaries,"[4] can fail to

[4] Quarterly Journ. Geol. Soc., November, 1883.

notice the similarity between the sections there given of the alluvial deposits of the estuary of the Severn and those of Tilbury. The former are given as consisting of—

Upper Clay.
Upper Peat.
Lower Clay.
Lower Peat.
Sands and Mud.
Gravel.

Of course, as at Tilbury, they show much local variation. He estimates the amount of subsidence, as measured by the present position of the lowest (Severn) peat-bed, as about 20 feet, an amount nearly coinciding with that given by the lower of the two Tilbury peaty seams interbedded with the inundation-mud—the lowest peaty bed being excluded for the reasons just given. We must not forget, however, that the present surface of Tilbury Marsh near the Docks is, as Mr. Pinker told us, between seven and eight feet below high-water mark, the shrinking being the result of the embankment and consequent drainage. The real amount of the subsidence, therefore, is greater by seven or eight feet than measurements to the present surface would give. Evidence of recent subsidence to a similar extent abounds around our shores. The facts as regards Essex have been noticed by Mr. W. H. Dalton in the 'Geological Magazine' for 1876, pp. 491–3.

The newspaper reports that I have seen describe the Tilbury skeleton as having been found at the top of the sand, at the depth of 32 ft.;[5] the beds in which it was discovered being said to be of Pleistocene age. This term Pleistocene seems to me objectionable in this case on two grounds. For it is not only unnecessarily vague as compared with the more precise term Alluvium, but it implies a much greater antiquity than that to which the skeleton is really entitled. Sir Charles Lyell, indeed, its inventor, proposed the disuse of the word Pleistocene more than twenty years ago, on account of the confusion it was found to cause, from the various meanings attached to it by different writers. Now, while it may be of

[5] See note at end of paper.

little importance what name is given to an ancient geological formation lying between two fairly definite horizons, great care is necessary in dealing with the most modern, with regard to which the evidence of relative antiquity is often extremely scanty and doubtful. However, I do not object to Pleistocene, here, on account of a preference for its equivalents, "Newer-Pliocene" or "Post-Pliocene," but because the Tilbury Dock Alluvium can only properly be classed as "Recent." For, if the term Recent is ever applicable, it must be to a series of strata the deposition of which began when our Physical Geography was almost precisely what it now is; and would be going on still, but for the embankment which confines the river and prevents its overflow. The writers of the newspaper paragraphs are also too much inclined to dwell on the depth at which the skeleton was found as a proof that it is rightly described as Palæolithic. Of course the mere fact that it was discovered deep down in alluvium that has received no addition to its thickness since the Roman occupation proves the *prehistoric* age of the skeleton. But human remains found at a depth of two or three feet in an old alluvial deposit formed when the river flowed at a height of twenty or thirty feet above its present level (which would be styled Palæolithic by universal consent) would have a claim to very much higher antiquity. They would be also divided from remains found in recent alluvium by a distinct interval of time, marked by a change in Physical Geography. And I may here remind you that flint implements were discovered by M. Boucher De Perthes in old river-gravel from 80 to 100 ft. above the present level of the River Somme; and that they have also been found in old Thames Valley deposits, 50 ft. above the present level of that stream. Many examples might also be given of human remains found in caves below a covering of stalagmite, and associated with the bones of extinct Mammalia, which, again, would rightly be styled Palæolithic. It is necessary, however, to bear in mind that the test of age in the latter case is by no means so conclusive as that afforded by presence in strata of a certain definite antiquity. For association with extinct Mammalia

gives a presumption rather than a proof of a certain age, inasmuch as such association is largely dependent on negative evidence for any weight it may possess, and negative evidence is always liable to be more or less upset by new discoveries.

The result of the drainage of the Lake of Haarlem gives a hint on this point. It was drained about thirty years ago; excellent sections were made in all directions across its bed, and carefully examined by skilled geologists. As many Dutchmen and Spaniards had perished in its waters three centuries ago, and it had always been the centre of a considerable population, plenty of human bones were expected. Yet none were found, the only remains of man being some wrecked Spanish vessels and a few coins; though the bones of men buried on battle-fields are not more decayed than those of horses interred with them. Thus, Mammalia unequal to the production of works of art might easily leave no signs of their former existence in a deposit in which hundreds or even thousands of them had been buried. (See Lyell's Antiq. Man, ed. iii., p. 147).

Thus, had extinct Mammalia and flint implements of the most primitive type been found associated with the Tilbury skeleton, no one would have been thereby more justified than now in calling the skeleton Palæolithic. For their presence in Recent strata could only show their extinction to be of more modern date than had previously been supposed, and could confer no additional antiquity on the beds themselves. Similarly, the rude and savage character of the Tilbury or any other skeleton can in itself give no presumption of Palæolithic rather than Neolithic age. No doubt, on the average, men of the rude Neanderthal type were decidedly commoner among the makers of the rude, or Palæolithic, implements than among the users of polished, or Neolithic, tools. But many Neanderthal-like men may have used polished implements, there being no inseparable connection between highly-finished implements and elegantly-shaped skulls.

In short, when terms like Palæolithic and Neolithic are used, on the one hand, in the provisional classification of

rude and polished implements, whose shape affords the chief evidence as to age; or, on the other, to divide human remains dating before and after a certain geological period, they are useful. But it must always be remembered that geological position furnishes the only absolute test of comparative age, and that to attempt to modify that test, where it exists, by appeals to other considerations is but to introduce confusion.

The true importance of the Tilbury skeleton—to judge from the accounts at present available—lies in the fact that it is a skeleton of prehistoric man much resembling that of Neanderthal, so much discussed twenty years ago. And skeletons of prehistoric man are so extremely rare, and his flint implements so (comparatively) numerous, that we may well rejoice more over one skeleton than over many bushels of flint implements, which cannot tell us whether their users were as elegantly made as some of the South Sea Islanders, or as clumsy as the Eskimo. Whether our Tilbury man will give rise to as much discussion as the Neanderthal skeleton remains to be seen. But, supposing the likeness between the two to be as great as it is reported to be,[6] the Tilbury specimen goes far to show that we have in each a normal type of prehistoric man, and not—as some anatomists used to assert of the Neanderthal—utterly abnormal examples. For the probability, always of the slightest, that the Neanderthal skeleton is that of an extremely exceptional person, sinks almost to zero on the finding of another specimen of the same singular type at Tilbury, especially when we consider the extreme rarity of prehistoric human skeletons. And it is worth noting that the age of these two examples is probably not dissimilar. All that can be confidently stated as to the Tilbury man's age is that he lived in the prehistoric era of Britain, many years before the embankment of the Thames during the Roman occupation. His skeleton having been found in the sand, below the inundation-mud, was no doubt deposited in the then channel of the river, at some point where the motion of the water was very slight. It is noticed

[6] Sir Richard Owen's illustrations—published since the reading of this paper—show that the two skulls strikingly resemble each other.

by Mr. Whitaker that "the general tendency of the Thames has been to cut its channel further and further southward, as it is on the north that we find the widest tracts of the old river-gravels, and on the south that the river comes nearest to the hills."[7] Now this tendency is nowhere so markedly shown as in the contrast between its shores at Gravesend and Tilbury. On the Kentish side we have chalk to the water's edge, and it is evident that the channel of the Thames at Gravesend and Rosherville was never southward of its present position. Turning, on the other hand, to the Essex shore, we see that a line drawn due north from Tilbury Fort, Docks, or Railway Station, would cross an alluvial flat about a mile and a half in breadth. Now where there is more or less alluvium on both shores it must be impossible to have any grounds for supposing remains deposited in a former channel, on one side, to be either earlier or later in date than other remains similarly deposited, but on the opposite shore of the present stream, and at an equal distance from it. But in the present instance it seems to me that we may fairly presume the river to have been occupied for many centuries in slowly and steadily cutting its channel further and further southward. Consequently human or other remains deposited in its channel when it flowed a mile due north of Tilbury Docks would be almost certainly older than the skeleton recently found.[8] And any estimate of age, derived from calculations as to the rate of deposition of the inundation-mud above the Tilbury man, is made additionally uncertain by the existence of the two stationary intervals marked by the peaty beds.

I will now briefly review the evidence as to the Neanderthal skeleton and its age. It was found, in 1857, in a limestone cavern near Düsseldorf, 60 ft. above the River Düssel, a tributary of the Rhine. This cavern opened on to the face of the river-cliff on one side, and was found to have a partly filled-up fissure communicating with the upper surface of the country, 100 ft. above, on the other. A section showing the

[7] 'Geology of the London Basin' (1872), p. 381.

[8] We learned from Mr. Pinker, in May, that the skeleton was found in the tidal basin or dock nearest to the Thames.

cave and its surroundings is given in Sir Charles Lyell's 'Antiquity of Man' (3rd ed., p. 76). Lyell remarks that the body may possibly have been washed into the cavern from above—through the fissure communicating with the surface, which slopes downwards to the cave at an angle averaging about 45 degrees. But the most simple and probable explanation of the existence of the skeleton in the cave seems to be that the man had permanent or temporary quarters there, and died therein quietly at last. For the skull and the other bones of the skeleton were found by the quarrymen working in their neighbourhood to be lying together in the same horizontal plane; and it is supposed (according to Lyell) that the skeleton was complete when found, but that "the workmen, ignorant of its value, scattered and lost most of the bones, preserving only the larger ones." And it seems almost impossible that the skeleton would have been either perfect or horizontal after a prolonged journey of weeks or months from the top of the irregular, jagged fissure to the bottom. It was covered by loam about 5 ft. thick, which had no doubt been washed down from the surface through the fissure; but there was no crust of stalagmite overlying the loam, and no bones of other animals were found in it. The antiquity of the Neanderthal man is thus marked only by the deposition of this loam above him. And the length of time this deposition occupied is a question without any possibility of even an approximate answer, on account of the probable variations in the capacity of the fissure, from time to time, as a channel for loam. There is nothing, however, to suggest an antiquity greater than, if so great as, that of the Tilbury man. The words of Dr. Schaaffhausen (translated by Mr. Busk) on this point are given in Prof. Huxley's book on 'Man's Place in Nature,' p. 129. He says:—"These remarkable human remains belonged to a period antecedent to the time of the Celts and Germans, and were in all probability derived from one of the wild races of North-Western Europe spoken of by Latin writers, and which were encountered as autochthones by the German immigrants."

It is evident, therefore, that the true importance of both

these most interesting skeletons lies not in their antiquity,—though they are both unquestionably entitled to be considered prehistoric,—but in their strange anatomical peculiarities, and in the fact that these peculiarities are nearly identical in each. As regards racial affinities, both the Neanderthal and Tilbury men are evidently most nearly akin physically to the robust, but coarse-featured, people of the round barrows of S.W. England, and of the Bronze Age, who are known to have been characterised by large frontal sinuses and supra-orbital ridges, and are considered by Mr. Elton and others to have been of the Finnish or Ugrian stock. And this view as to their race and period gives them just that measure of antiquity that is suggested by the positions in which the two skeletons were found.

Note (September, 1884).

Sir Richard Owen's work on the Antiquity of Man as deduced from the Tilbury skeleton—an enlargement of his Royal Society paper—being now published (August, 1884), we have the advantage of an authentic exposition of his views. The book is admirably illustrated, and the Neanderthal-like appearance of the Tilbury skull is very strikingly shown. It is evident, however, that the illustrious and venerable naturalist has never visited the Docks himself. Consequently he does not appreciate the difference of age between the older alluvial deposits of the Thames Valley (in which Mr. Worthington G. Smith has found so many Palæolithic implements) and the newer alluvium of Tilbury, as he would otherwise have done, but considers that in the Tilbury skeleton we have the first unquestionably Palæolithic *bones* of Man yet discovered. I am glad to be able to state that Mr. Worthington Smith's opinion as to the age of the Tilbury skeleton coincides with my own.

In the section of strata sent to Sir R. Owen by Mr. Donald Baynes, one of the engineers superintending the Dock excavations, the only inaccuracy in the newspaper accounts worth noting is corrected. The skeleton appears to have been found not at a depth of 32 ft., and at the top of the sand, but at

34·55 ft. and *in* the sand, 1·77 ft. below its upper surface. Above the sand was about 10 inches of "sand and decayed wood," material evidently brought down in the channel of the stream. Still ascending we get "mud and peat" 3·24 ft., and "mud" 1·76 ft. Above this mud was the lower of the two peat beds seen in the excavations on May 17th, its thickness being 3·58 ft., and the depth of its base from the surface 27·02 ft.

Appendix.

Notes on the New Docks at Lynn.

Mr. W. Whitaker having been good enough to show me the excavations for the above Docks, together with some of the remains found while making them, some months ago, it occurred to me that some remarks about them might form a useful supplement to those I have made about Tilbury. In order to get the latest information about the Lynn Docks, I wrote to Mr. Whitaker a few days ago, and from his reply (dated February 19th, 1884) I take the following details:—"The section at Lynn Docks consists of sand and shingle for about twenty to thirty feet, the top part being somewhat loamy. This sand and shingle is everywhere underlain by bluish-grey boulder clay. The commonest contents of the shingle were marine shells, bits of hard fossiliferous Kimeridge Clay, bones, fragments of pottery of various ages, and shoe-soles. Of upper-leathers only one attenuated representative was found towards the close of the work. Most of the shoe-soles had been worn; they have marks of stitching. I have seen 120 at least. One bone borer, one bone flute, one celt, and one beautiful arrow-head have been found. The Docks are now full of water."

The pipe, piece of pottery, and shoe-soles exhibited were found by Mr. Whitaker and myself during a visit I made to him in November, 1882. They were all in sand, fully 12 ft. below the surface. The oyster-spat and remains of some small polyzoan conspicuous on the pipe show that it was some time in the channel of the river before being covered up. The river flowed over the site of the New Docks before its new channel was made twenty years ago.

The finding of a tobacco-pipe 12 ft. below the surface shows us how poor a measure of age is afforded by mere depth, unchecked by other evidence, in the case of remains found in recent alluvial deposits. Engineers have estimated the growth in thickness of the inundation-mud of the Nile as being at the rate of five inches in a century. Consequently an article found in it at a depth of 12 ft. might be fairly supposed to be more than 2800 years old; while remains that have been deposited in a former channel of a river given to frequent changes of its course might be found at more than twice that depth without having any necessary claim to be considered ancient, even in the sense in which we speak of ancient history.

16 MAR
BRITISH MUSEUM
NATURAL HISTORY.

THE ESSEX FIELD CLUB.

FOUNDED JANUARY 10TH, 1880.

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Application for Membership should be addressed to the Hon. Secretary, WILLIAM COLE, 7, Knighton Villas, Buckhurst Hill, Essex.

NOTICES TO MEMBERS.

IMPORTANT NOTICE; 'TRANSACTIONS' *and* 'PROCEEDINGS.'—In order to facilitate editing and publication, the Council has resolved to issue the 'Transactions' and 'Proceedings' as separate publications, each in its own wrapper, and with distinct title-pages and indices when the volumes are completed. The two parts now sent out will therefore form respectively Pt. 1 of Vol. IV., 'Transactions'; and Pt. 1 of Vol. IV., 'Proceedings.' The Annual Reports, &c., for 1883 (*already sent*) and 1884 (*sent herewith*) will form Appendices 1 and 2 to Vol. IV. of 'Proceedings,' and must consequently be held over until that volume is completed. A copy of the REVISED RULES is also sent out herewith.

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LIBRARY AND MUSEUM.—The Librarian will thankfully receive books o Natural Science or Antiquities for the Library, and especially books, pamphlet engravings, &c., relating to, or in any way serving to illustrate, the history ar productions of the County of Essex. Specimens of Essex Natural Histor Geology, and Pre-historic Archæology, and preparations and diagrams illustrati of such subjects, will also be ver welcome for the Museum.

EAST ANGLIAN EARTHQUAKE, 1884.—The Club's Report on this remarkab phenomenon, drawn up by Prof. R. Meldola and Mr. W. White, will be publishe shortly at a price not exceeding 5s., and *Members* may buy copies at a conside able reduction. Mr. Lockyer will be glad to receive orders.

ERRATA.—In 'Transactions,' vol. iv., p. 88, fig. 1. The shaft in this draw is somewhat too large, the apex of the heap of *débris* is not under centre of sh and the lateral chambers are shown as being rather too near the shaft. Page line 2, *for* "marked," *read* "mark." Page 96, lines 2, 6, and 13, *for* "Witchlir *read* "Wichling." In 'Proceedings,' the thermometric readings on p. manifestly include some error which escaped notice at the time—lines 13 should therefore be cancelled.

WEST, NEWMAN AND CO., PRINTERS, HATTON GARDEN, LONDON.

N.B.—*See Notice of 'The Essex Naturalist' on back of Cover.*

Vol. IV.] **DECEMBER, 1886.** **[Part 2.**

TRANSACTIONS

OF THE

ESSEX FIELD CLUB.

Edited by William Cole, Honorary Secretary.

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The Authors only are responsible for the statements and opinions contained in their respective papers.

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1886.

XII.

Some Essex Well-Sections.

By W. Whitaker, B.A., F.G.S., Assoc. Inst. C.E.

[A combination of papers read before the Club on March 29th, 1884, and February 26th, 1885.]

Having collected accounts of the sections of many wells in Essex since the publication of the different Geological Survey Memoirs that treat of various parts of the county, I have thought that the Essex Field Club may be glad to have a description of such of these as have not found a place in any of those Memoirs, and are therefore left unprovided for, there being no prospect of the publication of any other Memoir in which they could appear.

With these are included an account of one section, which differs in some particulars from that already published, and of two others, taken from published sources, which are not likely to be generally accessible. I likewise give particulars of some old wells, recorded in the MSS. of the late Dr. J. Mitchell, for the use of which I have to thank Professor Prestwich. I have great pleasure also in thanking the engineers, well-sinkers and others, who have so kindly given me information, especially as I hope for more.

Of two sections only is there need to make special remark. The Loughton boring is one of the deepest in the London Basin, and is the third in the county that, after passing through the Tertiary beds, has pierced the Cretaceous beds to the bottom of the Gault, the other cases being at Harwich, and probably at Saffron Walden.

The Wickham Bishop boring, the deepest in the county, is of great interest, as showing a very sharp fold of the beds (? with a fault), so that the bottom part of the London Clay and the Reading Beds have been passed through twice. Had I not seen specimens from this boring, it would have been

difficult to understand the section. It is possible that the strong disturbance has affected the water-yielding power of the Chalk, by squeezing the rock and closing up the fissures, which may be the reason of the want of success in getting the needful supply of water.[1]

I had been content at first merely to note in what Geological Survey Memoirs accounts of Essex wells were to be found; but our President (Mr. Holmes) has asked me to expand this note into a fuller statement, with the localities of all the wells, so that our members may have an index, as it were, to the well-literature of the county, the Appendices on well-sections in the Memoirs including published accounts with new ones.

List of Geological Survey Memoirs which contain accounts of Essex Wells.

1. 'The Geology of the London Basin. Part 1. . . . . (1872)' Appendix 2., pp. 430—445. By W. Whitaker (Notes by H. W. Bristow, H. B. Woodward, and W. H. Penning). Fifty-eight well-sections at the following places are described:—Abridge, Barking, Battle Bridge, Bocking, Braintree, Brentwood, Bulphan Fen, Chelmsford, Childerditch, Dunton, East Ham, Epping, Foulness, Hainault Forest, Halstead, Havering, Horndon, Leigh, Leytonstone, Loughton, Maldon, Monkham Park, Nasing Park, Pitsea Hill, Plaistow, Potter Street, Pudsey, Rayleigh, Rochford, Romford, Rushley, Saffron Walden, Sewardstone, Southend, Stanford-le-Hope, Stifford, Stratford, Stroud Green, Vange, Victoria Docks, Waltham Abbey, Walthamstow, West Ham, West Hanningfield, and Witham.
2. 'The Geology of the Eastern End of Essex (Walton Naze and Harwich)'. By W. Whitaker (1877). Appendix 1, pp. 21—25. Seven well-sections at:—Dovercourt, Harwich, Pewit Island, Thorpe, and Walton.
3. 'The Geology of the N.W. Part of Essex and the N.E. Part of Herts.' . . . . (1878). Appendix 1, pp. 74—81. By W. Whitaker, W. H. Penning, and W. H. Dalton. Thirty-seven sections at:—Braintree, Bulmer, Coggeshall, Colne Engaine, Earl's Colne, Fairsted,

[1] [Observations on the Wickham Bishop boring are given by Mr. W. H. Dalton (Trans. E. F. C. vol. ii. (1881), p. 15), and by Mr. S. V. Wood (Trans. E. F. C. vol. iv. (1885), p. 83).—Ed.]

Feering, Gosfield, Great Canfield, Great Hallingbury, Halstead, Hatfield Broad Oak, Hatfield Heath, Hood End, Kelvedon, Little Hallingbury, Parndon, Quendon, Rickling Green, Saffron Walden, Saling, Sawbridgeworth, Terling, Thaxted, Tindon End, Wenden, Wicken Bonnett, and Witham.

4. 'The Geology of the Neighbourhood of Colchester' (1880). Appendix 1, pp. 13—18. By W. H. Dalton (and W. Whitaker). Fifteen wells at Ardleigh, Clacton-on-Sea, Colchester, Little Wigborough, Rowhedge (which should have been entered under East Donyland), Stanway, Tendring, Tollesbury, Weeley, and West Bergholt.
5. 'The Geology of the Country around Ipswich, Hadleigh and Felixstow.' 1885. Appendix A, pp. 106—110, p. 152. By W. Whitaker and W. H. Dalton. Thirteen wells at Dedham, Mistley, Ramsey, Bramble Island, Clacton-on-Sea, Colchester, East Mersea, Frinton, and Walton.

In all, therefore, 130 Essex well-sections have been described in these Memoirs, and to these 52 more are now added. The chief geological value of these records is, of course, in the details of the nature and thickness of the beds passed through; but, in addition to this, in many cases we gain information about the underground water-level, and, to some extent also as to the water-yield, both matters of practical importance.

I hope that if any member should get a record of a well-section that is not noticed, either in this paper or in one of the above-mentioned Memoirs, he will himself communicate such record to the Club, or will pass it on to me.

In the following sections the figures for thickness and depth stand for feet, unless otherwise stated. [Remarks enclosed within square brackets have been added by me to the original accounts of the sections].

Aveley Marsh.—*Marshfoot Farm. Within* 100 *yards of the house.* 1835.

Dr. J. Mitchell's MSS., vol. ii., p. 115, and vol. iii., p. 86. Water rose to the surface. Yield 15 gallons a minute.

	Thickness.	Depth.
A little vegetable mould and moor bog	20	... 20
Gravel and sand, with a little yellow clay ...	50	... 70
Chalk	37	... 107

Barking.

Dr. J. Mitchell's MSS., vol. iii., p. 85.

Through blue clay to sand and pebbles, with water, 57 feet.

Barking Side.—*Mission Home.* 1876.

Sunk and communicated by Messrs. Docwra & Son.

Shaft 72 feet, the rest bored.

Water-level about 66 feet down.

		Thickness. FT.	IN.		Depth. FT.	IN.
Surface soil		2	6	...	2	6
[Valley Drift, 10⅓ ft.]	Loam and sand	2	0	...	4	6
	Running sand	6	8	...	11	2
	Gravel	1	4	...	12	6
[London Clay, 143¾ ft.]	Yellow clay	2	6	...	15	0
	Blue clay	141	3	...	156	3
Grey [Oldhaven ?] sand		11	0	...	167	3
[Woolwich Beds], Green sand		25	0	...	192	3
Dark grey Thanet sand		51 ?	0	...	243	3
Chalk and flints		145	0	...	388	3

Birchanger.

Sunk and communicated by Mr. G. Ingold, of Bishops Stortford. Shaft.

Boulder Clay, 20 feet; London Clay, 47 feet; total 67 feet.

Sandy at bottom, with water.

Brook Street.—*On the high road W.S.W. of Brentwood.*

Dr. J. Mitchell's MSS., vol. iii., p. 75.

Water got after passing through about 340 feet of clay, and rose to within 100 feet of the surface.

Broxted.—*Sucksted Green.*

Sunk and communicated by Mr. G. Ingold. Shaft.

	Thickness.		Depth.
White and brown clay	14	...	14
Chalky sand and stones	2	...	16
Blue clay	13	...	29
Sand	11	...	40
Blue clay	19	...	59
Sand and gravel	2½	...	61½

Chadwell Heath ?. "*Between Chadwell Street and the turnpike-gate near the* 10 *mile-stone on the road from Romford to London.*"

Dr. J. Mitchell's MSS., ? vol. iii., p. 72.

Dug 45 feet; the rest bored.

Good supply of water.

Blue [London] Clay, to sand and black pebbles, 100 feet.

Two wells at Romford are given as the same.

Onigwell.—*Grange Hill.*

Dr. J. Mitchell's MSS., vol. iii., opp. p. 72.

Dug 228 feet; bored 170 feet.

Water abundant; rose to about 160 feet from the surface.

Through stiff clay, almost all blue, a foot or so at bottom mottled.

Chingford Mill. *For the East London Waterworks Company.* 1885

Communicated by Mr. W. B. Bryan, the Company's Engineer; and from Messrs. Docwra.

38 feet above Ordnance Datum.

Cylinder and shaft 50 feet; the rest bored (3 feet to 2 feet diameter).

Water rose from the bore to 5 feet 1 inch above the surface.

Water-level, in July, 1885, 2 to 3 inches below the surface.

		Thickness.	Depth.
Gravel		10	10
[London Clay, 54 ft.]	Blue clay	44½	54½
	Sandy clay	7½	62
	Black pebbles [basement-bed]	2	64
[Reading Beds, 41½ ft.]	Sand	4½	68½
	Mottled clay	3	71½
	White sand	11	82½
	Dark sand	7½	90
	Pebbles	1	91
	Dark sand	10½	101½
	Black pebbles	4	105½
[Thanet Sand, 36 ft.]	Dark sand	35	140½
	Flints	1	141½
Chalk and flints. Beds of flints at 236 feet deep (6 in.), at 243 (6 in.), at 249 (10 in.), and at 296 (4 in.). At 306 very hard chalk (for 4 feet down), at 336 very soft chalk, at 385 very hard chalk and flints, at 404 hard chalk and flints (for 42 feet down)		309½	451

Chrishall Green.

Sunk and communicated by Mr. G. Ingold.

Bored throughout. No water.

Red sandy loam	5	72
Blue boulder clay	67	

Corringham.—*Tilbury Brickfields Company.* 1886.

Made and communicated by Mr. R. D. Batchelor, of Chatham.

Shaft 180 feet; the rest bored.

		Thickness.	Depth.
[London Clay.]	Strong yellow clay	27	27
	Blue clay, with a large quantity of septaria	341½	368½
	Pebbles	½	369
[? Oldhaven & Woolwich Beds.]	Live sand, with shells	50	419
[Thanet Beds, 87 ft.]	Dark sand	74	493
	Dark clay	11	504
	Dark sandy clay	1½	505½
	Black flints, with green clay	½	506
Chalk, 214 ft.	Chalk with flints	96	602
	Chalk rock, very hard ...	½	602½
	Chalk with flints	94	696½
	Chalk rock, very hard	½	697
	Chalk with flints	23	720

Dagenham Hall.—*Sir T. Neaves.*

Dr. J. Mitchell's MSS., vol. iii., p. 72.

Good supply. Water rose 200 feet.

[Valley Drift.]	Brick-earth	1½
	Gravel	3
Blue [London] Clay. About half-way down a bed of fine whitish sand (13 in.), with small pebbles		400
To sand.....		about 404

Dedham.—*Grammar School.* 1885.

Boring, made and communicated by Messrs. S. F. Baker & Son. Water rises to 6 feet from the surface.

	Thickness.	Depth.
Turf and mould	3½	3½
Ballast [gravel] with water	8½	12

		Thickness.	Depth.
[London Clay, $4\frac{3}{4}$ ft.]	Sand and loam	2	14
	Brown clay	1	15
	Blue clay	$1\frac{3}{4}$	$16\frac{3}{4}$
[Reading Beds, $64\frac{1}{2}$ ft.; the bottom $4\frac{3}{4}$ ft. may be Thanet Beds.]	Light [-coloured] sand	$3\frac{3}{4}$	$20\frac{1}{2}$
	Coloured [mottled] clay	7	$27\frac{1}{2}$
	Light [-coloured] sand	5	$32\frac{1}{2}$
	Grey sand, with water	$\frac{1}{2}$	33
	Light [-coloured] sand	4	37
	Grey sand, with water	$5\frac{1}{2}$	$42\frac{1}{2}$
	Blue clay	$1\frac{1}{4}$	$43\frac{3}{4}$
	Green sand	$4\frac{1}{4}$	48
	Blue clay	$1\frac{1}{2}$	$49\frac{1}{2}$
	Hard grey sand	$\frac{1}{2}$	50
	Hard green sand	2	52
	Blue clay	$\frac{1}{2}$	$52\frac{1}{2}$
	Hard green sand	$1\frac{1}{2}$	54
	Blue clay	16	70
	Brown loamy clay	$6\frac{1}{2}$	$76\frac{1}{2}$
	Dark loamy sand	$\frac{3}{4}$	$77\frac{1}{4}$
	Dark grey sand, with water	$2\frac{3}{4}$	80
	Blue sandy clay	$\frac{1}{2}$	$80\frac{1}{2}$
	Flints	$\frac{3}{4}$	$81\frac{1}{4}$
To Chalk.			

Perhaps the top bed of sand may be the basement-bed of the London Clay.

Dunton.—*S.E. of Brentwood; Mr. Willoughby's.*

Dr. J. Mitchell's MSS., vol. iii., p. 76.

100 feet dug; bored 344 feet.

Water rose within 77 feet of the surface; contains sulphate of magnesia.

[London Clay.]	Yellow clay	25
	Blue clay, with selenite, pyrites, and wood	319
	To "water-rock"	354

Epping Waterworks.—*Section noted in Geological Survey Memoirs*, vol. iv., p. 434.

Another account, communicated by Messrs. Easton and Anderson, from particulars got from Messrs. Russ and Minns, is as follows:—

Shaft 225 feet; the rest bored.

Water-level 210 feet down.

	Thickness.	Depth
River [?] Deposits	10¼	10¼
London Clay	189¾	200
Woolwich and Reading Beds [must be partly London Clay]	105	305
Thanet Sand	49	354
Chalk	546 ?	900 ?

Fambridge Ferry.—*3 miles N. of Rochford.*

Dr. J. Mitchell's MSS., vol. iii., opp. p. 80.

[London Clay.]	Yellow clay	30
	Blue clay	330
	"Water-rock" [basement-bed?]	2
		362

Felsted.—*Grammar School.*

Over 248 feet above Ordnance Datum.

Communicated by Messrs. Easton and Anderson, from particulars got from Mr. Chancellor, of Chelmsford. Additional particulars from Mr. D. S. Ingram.

Shaft 140 feet; the rest bored.

Water-level about 81 feet down.

	Thickness.	Depth.
Surface earth (shallow)		
[Glacial Drift.] Boulder clay, ? 35 or 40 feet. ? Sand and stones, irregular, 12 or 15 feet (from which the supply was once got ...	about 51	51
London Clay	209	260
Reading Beds (variously coloured sands, tenacious black clay with red patches, and a layer of small black flints)	44	304
Chalk	100	404

Grays.—*Brooks, Shoobridge & Co.'s Cement Works.*

Made and communicated by Messrs. G. Isler & Co.

Shaft 10 feet; the rest bored.

Water-level 12 feet down. Yield 9000 gallons an hour.

		Thickness.	Depth.
Gravel		24	24
Chalk	Chalk	6	30
	Chalk and flints	19	49
	Soft chalk	7	56
	Chalk and flints	15	71
	Hard chalk	5	76
	Chalk and flints	64	140

Hempstead.—*Royal Oak Inn.*

Sunk and communicated by Mr. G. Ingold.

Brown clay	3
Dark clay	7
Light blue clay.....	23
	33

Henney.—*Gentries Farm.*

Made and communicated by Messrs. G. Isler & Co.

Water-level 150 feet down. Yield, through a 2½ inch pump, 180 gallons an hour.

		Thickness.	Depth.
Shaft, through made ground and sand (the rest bored)		...	48
[Glacial Drift.]	Sand	21½ ...	69½
	Ballast [gravel]	6½ ...	76
[London Clay, 40 ft.]	Blue clay	32 ...	108
	[Basement-bed] Sand	6½ ...	114½
	[Basement-bed] Hard ballast [? pebbles]	1½ ...	116
Reading Beds, 34 ft.]	Sand	8½ ...	124½
	Clay	1½ ...	126
	Sand	3 ...	129
	Clay	21 ...	150
[Thanet Sand, 10 ft.]	Dead dark sand	2 ...	152
	Black sand	6 ...	158
	Green sand	2 ...	160
Chalk		80 ...	240

High Laver.—*The School.*

Information from Mr. Penning, late of the Geological Survey.

Boulder Clay	24
Sand and gravel	8
	32

Ilford.—*Broadway.*

Dr. J. Mitchell's MSS., vol. iii., p. 71.

Dug 63 feet; the rest bored.

Water rose to within 30 feet of the surface.

		Thickness.	Depth.
Gravel and yellow clay.....		10 ...	10
[London Clay]	Blue clay	93 ...	103
	[? Basement-bed] Water-rock	2 ...	105
	[? Basement-bed] Black pebbles, with a very little sand	3 ...	108
Reading Beds,	Yellow clay	8 ...	116
	To sand and black pebbles, with much water.		

Ilford.—*Near the row of houses opposite the Red House.*

Same authority, p. 72.

Dug 87 feet; the rest bored.

Water abundant, and rose within 52 feet of the surface.

Old well	58
Blue [London] Clay	241
Sand and black pebbles [basement-bed]	2
	301

Little Parndon.—*Hare Street Green.*

Sunk and communicated by Mr. G. Ingold.

Dug throughout. Water in the sand.

	Thickness.	Depth.
Gravel and sand	18	18
White loam	3½	21½
Sand	½	22
Loam	2	24
Loose chalky sand	5½	29½

Longford.—*Near Maldon.*

Dr. J. Mitchell's MSS., vol. iii., p. 80.

Water rose 5 feet above the ground.

Through [London] clay to fine sand with shells, 150 feet.

Loughton.—*Great Eastern Railway Station.* 1874–6.

From a drawing by Mr. A. N. Langley in the Geological Society's Library, from specimens and from information from Mr. Langley.

Shaft 101 feet; the rest bored.

Water rose to within 64 feet of the surface at the rate of about 2000 gallons a day, May, 1874.

	Thickness.	Depth.
[London] Clay	167	167
[Reading Beds, 36 ft.] Sand	26	193
[Reading Beds, 36 ft.] Clay and stones	10	203
Fine [Thanet] Sand	40	243
Chalk. [At 850 feet a specimen of chalk with some green grains; at 871 feet of rather sandy chalk with some green sand]	648½	891½
Chalk, with layers of green sand [? Upper Greensand, except top few feet. Specimen of green sand, with some chalk (? carried down by boring-tool) at 922 feet]	37	928½

		Thickness.		Depth.
[Gault.]	Chalk [? whitish calcareous clay] $4\frac{1}{2}$ feet. [Specimens of Gault clay from 950 feet down. At the bottom some pieces of phosphatic nodules, such as occur at the base of the Gault]	172 ?	...	about 1100

An account from Mr. T. Tilley, who bored the lowest part of the well, is as follows:—

		Thickness.		Depth.
To bottom of grey chalk		894	...	894
[Upper Greensand, 30 ft.]	Green sand and brown loam	8	...	902
	Green sand	8	...	910
	Grey chalk [? calcareous sandstone]	4	...	914
	Green sand	10	...	924
[Gault.]	Grey chalk [? calcareous whitish clay]	31	...	955
	Gault (not bottomed).....			

This boring, one of the deepest in the London Basin, is the second in Essex that, after passing through the Tertiary beds, has pierced the Chalk, the Upper Greensand, and the Gault, the other being at Harwich. See 'The Geology of the Eastern end of Essex (Walton Naze and Harwich).'

Maldon.—*Warren's Foundry, near the Railway Station.*
Information from Mr. Hatley (to Mr. Dalton).

Gravel	21
London Clay	130
To sand.....	151

Maldon (Heybridge).—*Bentall's Nut and Bolt Factory.*
1872.

Information got by Mr. W. H. Dalton from Mr. Barham, well-sinker, and from specimens.

Shaft, 75 feet; the rest bored.

Maiden spring 90 feet down.

			Thickness.		Depth.
[Valley] gravel			9	...	9
[London Clay.]	Clay		105	...	114
	[Basement-bed]	Sandstone..... over	1	...	115
		[2] Sand [I saw broken shells in some of this]	11	...	126

[2] [Some of this sand may belong to the Reading Beds. The shells were decidedly from the "basement-bed."]

Maldon (Heybridge). — (*a*), *Mr. Bentall's house, about 100 yards from the above.* 1872. (*b*), *By the Churchyard.*

Same authority as above.

	(*a*)	(*b*)
[Valley] gravel	9 to 10	10 to 11
London Clay	116	115
Sandstone	a few inches	a little
To sand and water	126	126

Plaistow Wharf.—*Lyle & Co.* 1883.

Made and communicated by Messrs. Docwra.

Bore of various diameters.

		Thickness.	Depth.
Bungham [? made ground or alluvium ?] ...		14 ...	14
Ballast [gravel]		21½ ...	35½
[London Clay, 15 ft.]	Blue clay	14 ...	49½
	Black [flint] pebbles	1 ...	50½
[Woolwich Beds, 39 ft.]	Dark Sand	18½ ...	69
	Blue clay, with shells	13 ...	82
	Yellow clay.....	7½ ...	89½
[Thanet Sand, 61½ ft.]	Light green loamy sand ...	2 ...	91½
	Loamy green sand	59½ ...	151
Chalk. 18 in. bed of flints at the depth of 310 feet, another at 396, and an 18 in. bed of hard chalk at 400		484 ...	635

Possibly some of the sand classed as Thanet may belong to the Woolwich Beds.

Prittlewell.—*For the Southend Waterworks. About a tenth of a mile S.S.E. from the Vicarage.* 1882.

Communicated by Mr. T. Hawksley, F.R.S.

Shaft about 360 feet; the rest bored.

Water-level 143 feet down.

		Thickness.		Depth.	
		FT.	IN.	FT.	IN.
Soil.....		1	6 ...	1	6
[Post-Glacial Drift, nearly 45 ft.]	Brick-earth	8	6 ...	10	0
	White loam and sand ...	1	0 ...	11	0
	Red sand, with a 3 inch layer of brown loam a foot down, and a 2 inch layer 2 feet down	4	7 ...	15	7
	Gravel and sand	4	8 ...	20	3
	Yellow sand; junction with bed below showing a dip	26	0 ...	46	5

		Thickness. FT.	IN.	Depth. FT.	IN.
[London Clay, 362 ft.]	Yellow clay	2	0	48	5
	Clay	360	1	408	6
[Oldhaven Beds, Woolwich Beds, and Thanet Beds.]	Sands	162	6	571	0
	Green flints	0	6	571	6
Chalk, 305 ft.	Chalk with flints	118	6	690	0
	Hard chalk without flints	35	0	725	0
	Soft chalk with flints	118	0	843	0
	Very hard chalk with flints	22	0	865	0
	Soft chalk with flints	11	7	866	7

This well is remarkable for the great thickness of sand and gravel above the London Clay, and for the thickness of the Lower London Tertiaries (the beds between the London Clay and the Chalk), in which it agrees with the Southend well, noticed in Geological Survey Memoirs, vol. iv., p. 441.

Prittlewell.—*Vicarage.*

From Dr. R. T. Thorne, of the Local Government Board.

Surface soil, brick-earth, gravel, and sand	over 40
London Clay	about 380
Lower London Tertiaries, ? depth.	

Quendon.—*Hall Farm.*

Sunk and communicated by Mr. G. Ingold.

Shaft 40 feet; the rest bored.

Water at 29 feet.

Gravel and clay	18
Soft white chalk, with flints	77
	95

In an old well at the Hall, 90 feet deep, there is red sand at the bottom.

Radwinter.—*Brewery, near the Church.*

Sunk and communicated by Mr. G. Ingold.

Shaft 28 feet; the rest bored.

Water-level 21 feet down.

		Thickness.	Depth.
Made earth		1	1
[? Boulder Clay.]	Brown clay	4	5
	White clay	5	10
	Dark stony clay	4	14
	Blue clay	41	55
Chalk		25	80

Rettenden.—*Battle Bridge. Mr. W. Clarke's, about half a mile from the River Crouch.* 1884.

Probably about 80 feet above high-water mark.
Sunk and communicated by Messrs. Legrand & Sutcliff.
Bored throughout. Water-level 64½ feet down.

		Thickness.	Depth.
Top soil		10½	10½
[London Clay.]	Clay, with occasional thin clay-stones	395	405½
	Sandy clay	8	413½
	Stone	½	414
[? Reading Beds,]	Green sand	7	421
	,, ,, with water	2	423

It is possible that the green sand may be merely the wet sandy basement-bed of the London Clay. Even if not so the depth to the bottom of the London Clay would be 414 feet, which shows a great thickness of that formation, the top part of which is not here present.

Roydon Hamlet.—*Old House Farm, near Brickworks.*

Sunk and communicated by Mr. G. Ingold.
Dug throughout. Strong spring from the gravel.

[Glacial Drift.]	Blue [Boulder] clay, with stones. Some gravel from 30 to 40 feet down	63
	Yellow loam	3
	Pebbly gravel and sharp sand	11
		77

Sheering.—*Coffee Tavern.*

Sunk and communicated by Mr. G. Ingold.
Shaft. Water rose 14 feet from the bottom.
White and blue Boulder Clay 43 feet.

Shelley (*near* **Ongar**).—*Cottages near the Red Cow Inn.*

'Chelmsford Chronicle,' March 22, 1878.

Dark marl, bedded with much small chalk and shells, about 30 feet.
Hard rock of cemented gravel.
Fine mud, bored through a short distance to water [? London Clay].

Southchurch.

Information got by Mr. Dalton from Mr. Purkiss, well-sinker.
Water up to 36 feet below the surface.

To base of London Clay	355
Sand	40
	395

Southend.—*On the Green, Lower Southend.* About 1850.
Communicated by Mr. Scott (of the Royal Hotel).
Surface about high-water mark.

Sand and shingle [beach]	35
Blue [London] Clay ..... about	440
To sand and water	475

Another well near by, 380 feet.

According to Mr. Purkiss a well at the Royal Hotel Mews reached the base of the London Clay at 370 feet; but these figures would seem to be too low, as also is the case with the following (from the same authority, through Mr. Dalton):—

Southend.—*Railway Station.*

Gravel	15
London Clay	340
Sand	40
	395

Stanstead.—*New Almshouses.*

Sunk and communicated by Mr. G. Ingold.
Shaft 46 feet; the rest bored.
Water 47 feet down.

		Thickness.	Depth.
[Drift.]	Brick-earth	4	4
	Gravel and loam, very irregularly bedded	30	34
	Gravel	12	46
Chalk		56	102

Stratford.—*Messrs. Howard & Son's Chemical Works. On the main road, about midway between Bow and Stratford.* 1884.
Sunk and communicated by Messrs. Legrand & Sutcliff.
Shaft 14 feet; the rest bored.
Water-level 31 feet down.

		Thickness. FT.	IN.	Depth. FT.	IN.
Made ground		8	0	8	0
Peaty loam		5	6	13	6
Blue [? London] Clay		2	6	16	0
[? Blackheath Beds, 13 ft.]	Small shells	3	0	19	0
	Black [flint] pebbles	10	0	29	0
[Woolwich and Reading Beds, 58 ft.]	Dark brown clay	4	6	33	6
	Dark brown sandy clay, with shells (? oysters)	5	0	38	6
	Dark clay	2	0	40	6
	Brown sandy clay	1	6	42	0
	Drab live sand, with thin bands of clay	12	0	54	0
	Light-coloured clay	1	0	55	0
	Dark clay, with shells	7	0	62	0
	Clay and limestone	2	10	64	10
	Mottled sandy clay	1	2	66	0
	Mottled sandy clay, with small black [flint] pebbles	1	6	67	6
	Light-coloured sandy clay, with pebbles	2	6	70	0
	Dark green sand	10	0	80	0
	Green sandy clay, with a few shells (oyster)	2	0	82	0
	Grey sandy clay and black [flint] pebbles	5	0	87	0
[Thanet Sand, 48½ ft.]	Live grey sand	40	0	127	0
	Dead grey sand	8	0	135	0
	Green flints	0	6	135	6
Chalk and flints		114	6	250	0

Takeley.—*Reindeer Inn, lowest part of village.*

Sunk and communicated by Mr. G. Ingold.

Shaft 20 feet; the rest bored. No water.

White and blue Boulder Clay		72
[London Clay.]	Brown clay	2
	Blue clay	4
		78

Thames Haven.—*Cattle Landing Station. On the marsh, about 450 feet from the river-bank.*

'Iron,' vol. xiv., pp. 422, 423 (1879), and Trans. Sanitary Inst., vol. i., p. 203 (1880). With analyses of the water from different depths.

Bored throughout, 16 in. diameter, decreasing to 9 in. and 6 in.

Water overflowed. When the boring was at the depth of 78¼ feet the water-level was 5½ feet below the marsh-level;

at 122½, 6⅓ feet; at 200, 4⅔ feet; at 274 it ebbed and flowed with the tide, to 6 in. above and 6 in. below the marsh-level; at 360, 11½ in. above the marsh-level; at 502, 14 in.; at the last, 19 in. (at high-water spring tides). Lowered to a depth of 80 feet by hard pumping. Yield, at depth of 360 feet, 520 galls. an hour at 100 feet deep; at 502 feet, 1300 galls. an hour for the veins at 460 feet and 2200 for those at 502. 26,000 galls. a day taken.

		Thickness.			Depth.	
		FT.	IN.		FT.	IN.
[Alluvium ?, 50¾ ft.]	Light-brown clay	16	0	...	16	0
	Peat	2	6	...	18	6
	Soft ooze	4	2	...	22	8
	Grey sand	25	10	...	48	6
	Grey clay, stones, and shells, with thin veins of black greasy sand	2	3	...	50	9
[Valley Gravel?]	Sand and stones (about 3½ in. diameter) forming a dark gravel	27	6	...	78	3
[? London Clay, 40¼ ft.]	Stiff dark brown clay	28	9	...	107	0
	Sand and clay in veins	5	10	...	112	10
	Sandy clay and shells	1	2	...	114	0
	Sandy clay	1	6	...	115	6
	Sandy clay and pebbles	3	0	...	118	6
[3] [? Oldhaven Beds, 5¼ ft.]	Light-coloured running sand, with water	4	0	...	122	6
	Sand and oyster-shells	1	3	...	123	9
[3] [Woolwich and Reading Beds, 33¼ ft.]	Dark sand, with shell fragments	9	3	...	133	0
	Yellow ochreous sandy clay	3	0	...	136	0
	Greenish sandy clay	9	0	...	145	0
	Fine green light-coloured sands, firm and dry	10	0	...	155	0
	Dark sand and pebbles, with fragments of shells	2	0	...	157	0
[3] [Thanet Beds, 111½ ft.]	Fine greenish sand: top 9 ft. full of water, more solid and close at 170 ft. deep, very hard and dry at 180 ft., the bottom 40 ft. with water	76	0	...	233	0
	Greenish clayey sand; plastic at 246 ft. deep, at 253 ft. dry and firm, at 256 ft. looser, at 259 to 262 ft. bands of hard dry sandy clay, bottom 6 ft. more or less rotten sand and clay	35	0	...	268	0
	Green-coated flints	0	6	...	268	6

[3] It is difficult to make out these subdivisions of the Lower London Tertiaries.

	Thickness. FT.	IN.	Depth. FT.	IN.
Chalk: marly from 308 to 355 ft. deep, with flint water-bearing veins at 360 ft., greyish and firm at 367, hard and white at 426, hard at 440, soft with flints and water-veins at 460, darker and harder at 475, flint-veins full of water at 502, grey and waterless at 506½, white with flints and water at 521, grey without water at 529, soft with cavities, flint-veins further apart but full of water, at 536, hard and dark 540—545, softer and whiter at 550, white and marly 566—572	303	6	572	0

Tilbury Fort.—(*Old Well*).

'Gentleman's Magazine,' vol. lxviii., p. 565 (1798).

Dug 48 feet; the rest bored.

Dry earth [made ground?], thin.
Clayey beds, with leaves and branches of trees, about 48 ft.
Quicksand.
Stiff marl, ? 30 ft.
Chalk-stones found at a depth of about 80 ft.

Tilbury Fort.—(*Newer Well*). 1849.

Communicated by Col. E. M. Grain, R.E. With further information from Lieut.-Col. Brine, R.E.

Shaft and cylinders, 31 feet; the rest bored.

Water, March 22nd, 1849, good; April 19th, impure; May 25th, good; since become quite unfit for domestic purposes (although pipes were carried to a depth of 490 feet).

		Thickness.	Depth.
Made ground		3 ...	3
[Alluvium, 41 ft.]	Strong mud or blue clay ...	11½ ...	14½
	Peat with clay.....	5½ ...	20
	Clay	3 ...	23
	Dark peat.....	8 ...	31
	Stiff clay	8 ...	39
	Dark peat	5 ...	44
[River Drift, 23½ ft.]	Dark sharp sand	7 ...	51
	Sharp sand and gravel	4 ...	55
	Light [-coloured] sharp sand and gravel	12½ ...	67½
Chalk		517 ...	584½

Upminster.—*Rectory.*

Dr. J. Mitchell's MSS., vol. iii., p. 75.

Dug 90 feet; the rest bored.

		Thickness.	Depth.
Sand, gravel, and brick-earth		30	
Blue [London] clay, ending in brown sand and black pebbles [basement-bed ?]		150	

Vange.—*Brickyard.* (*Mr. T. L. Curtis*). 1884.

Sunk and communicated by Messrs. Legrand & Sutcliff.

Shaft 100 feet; the rest bored.

		Thickness.	Depth.
London Clay		395	395
[? Oldhaven and Blackheath Beds, 42½ ft.]	Dead sand and shells	3½	398½
	Grey sand	2½	401
	Pebbles	1	402
	Dead sand	4	406
	Grey blowing sand	12½	418½
	Pebbles	½	419
	Grey sand and pebbles	2	421
	Grey sand	17½	438½
[Woolwich and Reading Beds, 47 ft.]	Sandy clay	2	440½
	Peat [lignite ?]	2	442½
	Blue clay	3	445½
	Brown clay	5	450½
	Sand and shells	5	455½
	Peaty clay	20	475½
	Sand and pebbles	10	485½
[Thanet Beds, 38½ ft.]	Dead sand	22	507½
	Dark sandy clay	12	519½
	Dark greenish clay	3	522½
	Green flints	1½	524
Chalk. Soft and impure, with very little water; a 3 ft. bed of clay at 600 ft., and then a mixture of clay, chalk, and flints; then white chalk and flints		177	701

This boring is of interest as showing what seems to be a fairly thick development of the Oldhaven Beds some way from their outcrop. In this series and in the beds below, the sands (which would have been expected to yield water) were blowing sands, and to pass through them the pipes had to be kept full of water.

Walthamstow.—*Clay Street.* (*Mr. Robertson's*).

Dr. J. Mitchell's MSS., vol. iii., p. 83.

Dug 90 feet; bored 100. To chalk (190 feet).

Warley.—*Parsonage.*

From Dr. J. Mitchell's MSS., vol. iii., p. 75.

Dug 100 feet; bored 280 feet.

The land below the blue [London] Clay reached at 390 feet.

Wickham Bishop.—*Site of proposed "Second Essex Asylum,' Heathgate Farm, S. of Chancery Wood.* 1878–1880.

Sunk and communicated by Messrs. Easton & Anderson, and from specimens.

234 feet above Ordnance Datum.

Shaft and cylinders 304 feet; the rest bored.

Dip about 18 in. in the outer diameter (6 ft. 8 in.), of the bottom part of the shaft = 15°.

Yield, when drawn at a depth of about 80 feet below sea-level, only about 10 gallons a minute.

		Thickness.		Depth.
Surface soil		1½	...	1½
[Drift, 41½ ft.]	Yellow clay	11½	...	13
	Sand and gravel, with surface-springs	30	...	43
[London Clay, 252 ft. Specimens of iron-pyrites (stems of plants) and of *Rostellaria* and bivalves in septaria.]	Blue clay	160	...	203
	Black clay	53	...	256
	Stiff black clay and cement-stones	19	...	275
	Running sand and septaria, with a strong spring of salt ferruginous calcareous water; fragments of shells found (according to a note from Mr. H. G. Dixon); 3 in. of black pebbles at bottom	20	...	295
[Woolwich and Reading Beds.]	Hard mottled blue and grey sand and clay	2½	...	297½
	Red and blue mottled clay [specimen, about 2 feet down, of brown and grey mottled clayey sand; another, lower, as described]	14	...	311½
	Mottled red and grey clayey sand [specimen]	2	...	313½
	Fine sand	3¼	...	316¾
	Red and blue hard clay [specimen mottled brown and grey plastic clay], passing down into clayey greensand [specimen]	12¾	...	329½
[? London Clay, repeated by fault ?.]	Yellow clay [specimen, brown sandy clay like London Clay]	2	...	331½
	Very stiff marly clay [specimen, mottled clay, partly sandy]	12	...	343½
	Very stiff silty loam [specimen, brownish grey]	7	...	350½

		Thickness.		Depth.
[? London Clay, repeated by fault ?.]	Hard cement-stones [specimen with loam, as above]	1	...	351½
	Mottled silty clay [specimens, brown clay and sandy clay, with a bit of green sand, ? carried down by tool]	13¼	...	364¾
	Mottled clay and cement-stones [specimen, stone with shell, ? *Cardium laytoni*, ? basement-bed of London Clay]	5	...	369¾
	Silty clay and green sand [specimen, brown and green clayey sand, ? basement-bed]	4	...	373¾
	Cement-stones [specimen like that from 5 feet higher]	¾	...	374½
	Mottled clay [specimen, brown clay, partly sandy]	7½	...	382
	Sand and shells [specimen, ? basement-bed]	1	...	383
[Woolwich and Reading Beds.]	Mottled clay and sand [specimen, clayey green sand, mottled red]	4 ?	...	387 ?
	Mottled clay [specimen, light-brown sandy clay]	7	...	394
	Hard reddish clay [specimen, red and grey mottled plastic clay]	5	...	399
	Red clay [specimen somewhat mottled clay, dark brown, partly sandy]	7 ?	...	406
	Hard sandy clay	5	...	411
	Light-coloured clay [specimen, pale green-grey sandy clay]	10	...	421
[Thanet Sand.]	Sandy loam	1	...	422
	Dark sandy loam [specimens, from top 20 feet, fine grey sand; from next 28 feet, fine grey sand, with green grains; from bottom 7 feet, fine grey sand.] About 4 in. of flints at base	55	...	477
Chalk, 703 ft.	Chalk, with flints	523	...	1000
	Hard and compact chalk, with some flints in the upper part [specimen, white chalk with pale green-grey streaks]	46 ?	...	1046
	Softer chalk	4 ?	...	1050
	[Chalk]	130	...	1180

The possibility of the disturbance of the beds having stopped the flow of water has already been alluded to (pp. 149–50).

Witham.—*Railway Station.*

Correction to account in Geological Survey Memoirs, vol. iv., p. 445.

Level of rails about 80 feet above Ordnance Datum.

From a letter from J. Darby to the Rev. O. Fisher, 1868.

[Post-Glacial Drift.]	Coarse gravel [in face of cutting].	about 70 ft.
	Sand	
	Mixed clay	
	Layer of chalk	
	Very hard coarse gravel	
[Glacial Drift.]	Light-coloured clay, becoming blue clay with flints	
[Eocene Tertiaries.]	Dove-coloured sand (less green sand than usual).....	120 ft.
	A little red sand, no mottled or plastic clay	

["If, as is possible, the bore-hole was dry, the London Clay might come up as what is here called 'dove-coloured sand,' and the water might be got, as in other wells near, from a bed *in* the London Clay."—Note from Mr. W. H. Dalton.]

An account of a well at Brentwood came to hand too late for insertion, and it will therefore form the starting-point of another collection.

XIII.

The Life and Work of John Ray, and their relation to the Progress of Science.[1]

By Prof. G. S. Boulger, F.L.S., F.G.S., F.R.G.S., &c.

[Read January 31st, 1885.]

Having on previous occasions addressed you on the earliest and unconscious action of man on the flora of our county, and on the early history of the science of Botany as bearing on our peculiar territory, I think I can hardly choose a more suitable topic for my address to you this evening than the biography and life-work of one who is not only by far the greatest naturalist belonging to our county, but, with one possible exception, whose name will occur to you all, the greatest naturalist that England has ever produced.

I know no period of equal length so full of varied interest in the history of English politics, English literature or English thought, as the seventy-seven years, from 1627 to 1704, that are covered by the life of that illustrious naturalist, John Ray, whose name will go down to all time with those of Linnæus and Darwin as that of one of the princes of Biology. In passing from the reign of Charles I. to those of William III. and Anne, we pass in politics from an era of personal, to one of responsible parliamentary government; and a change perhaps equally great came over the spirit of our literature and philosophy between the death of Bacon and those of Dryden, Ray, and Locke.

Speaking of the time when Ray was a young man, an eminent critic has said:—"Everywhere there was in those days the quickened spirit of enquiry. It entered into

[1] [This essay formed the main portion of the address of Prof. Boulger as President of the Club at the Annual Meeting on January 31st, 1885. On the score of convenience it is printed here as a paper, and the introductory observations will be given in the report of the above-mentioned meeting in the 'Proceedings.'—Ed.]

politics; and patriotic thinkers, representing many forms of mind, active in fresh examination of the framework of society, sought to find their way to the first principles on which established forms of government are founded, and part false from true. It entered into religion; and devout men, also representing many forms of mind, went straight to the Bible as the source of revealed truth, seeking to find their way to the first principles on which established forms of faith are founded, and part false from true. It entered into science; and followers of Bacon, hoping to draw wisdom from the work of the All-wise, went straight to Nature as the source of all our material knowledge, and sought, by putting aside previous impressions where they interfered with a new search for truth, to find their way to the first principles upon which a true science is built." At the close of his life, the philosopher best known to us as Lord Bacon wrote:—"For my name and memory I leave it to men's charitable speeches, and to foreign nations, and the next age"; and it was upon the next age that his scientific work, example, and influence really told. The age of Elizabeth, pre-eminent in creative imagination, was not perhaps to be expected to be equally signalised by the critical spirit of scientific enquiry; and the only important discovery in English science before the Restoration was that of the circulation of the blood by Harvey. When the study of science was first passing from the empiricism of mere speculation, superficial observation, and unsystematic enumeration to the stage of causal correlation, it was to the method of Bacon that our thinkers first appealed. In the words of the late Mr. J. R. Green:—"Even before the outburst of the Civil War a small group of theological Latitudinarians had gathered round Lord Falkland at Great Tew. In the very year when the King's standard was set up at Nottingham, Hobbes published the first of his works on Government. The last Royalist had only just laid down his arms when the little company who were at a later time to be known as the Royal Society gathered round Wilkins at Oxford. It is in this group of scientific observers that we catch the secret of the coming

generation. From the spiritual problems with which it had so long wrestled in vain, England turned at last to the physical world around it, to the observation of its phenomena, to the discovery of the laws which govern them. The pursuit of Physical Science became a passion; and its method of research, by observation, comparison, and experiment, transformed the older methods of inquiry in matters without its pale. In religion, in politics, in the study of man and of nature, not faith but reason, not tradition but inquiry, were to be the watchwords of the coming time. The dead-weight of the past was suddenly rolled away, and the new England heard at last and understood the call of Francis Bacon." In this seventeenth century renaissance, this rationalistic illumination, no mean part was to be played by the son of the blacksmith of Black Notley, John Ray.

Ray was born at Black Notley, near Braintree, probably on November 29th, 1627, since his baptism is registered on June 29th, 1628, though his birth is commonly recorded in November, 1628. His father was Roger and his mother Elizabeth Ray, but until the year 1670 the naturalist spelled his name with a W, as he says "antiquâ et patria scriptione immutatâ." He was educated, until nearly seventeen, at Braintree Grammar School, when, on June 28th, 1644, he entered at Catherine Hall, Cambridge, a year before his future friend, Isaac Barrow, left Felstead for Trinity College. The year before Abraham Cowley, holding Royalist views, left Cambridge for Oxford, and in this same year 1644, Robert Boyle, having returned from Geneva, and, by the advice of his sister, Lady Ranelagh, turned away from the strife of parties, made the acquaintance of the enlightened Pole, Samuel Hartlib, and of his friend John Milton, whose tract "Of Education" was in this year dedicated to Hartlib. In the following year, 1645, began those informal meetings in London of men interested in science, from which sprang the Royal Society, and in which the leading spirits were John Wilkins, afterwards Warden of Wadham College, Oxford, brother-in-law of Cromwell, Master of Trinity College, Cambridge, and Bishop of Chester, and John Wallis, then Rector

of St. Gabriel, Fenchurch Street, and Secretary to the Westminster Assembly, and afterwards Savilian Professor of Geometry at Oxford. Fifty years later the latter wrote of these early days :—"Our business was (precluding matters of Theology and State-affairs) to discourse and consider of philosophical enquiries, ... some of which were then but new discoveries, and others not so generally known and embraced as they now are ; with other things pertaining to what hath been called the New Philosophy, which, from the times of Galileo at Florence, and Sir Francis Bacon (Lord Verulam) in England, hath been much cultivated." . . . .

In 1646 Ray left Catherine Hall for Trinity College, to be under the tuition of Dr. Duport, the teacher, and predecessor in the Regius Professorship of Greek, of Isaac Barrow ; and, having probably graduated together in 1648, the two fellow-students were elected to Minor Fellowships in 1649,—the year in which Wallis's appointment to the Savilian Professorship transferred the active centre of scientific study from London to Oxford, whither Wilkins had gone in the previous year, and where, at the rooms of Dr. William Petty, the first of English economists, at Wadham College, and at the house of Robert Boyle, where Lady Ranelagh acted as hostess, the gatherings, previously held in London, were resumed.

The varied character of Ray's erudition is evinced by his appointment as Greek lecturer of his college in 1651, as mathematical lecturer in 1653, and humanity reader in 1655, he having taken his Master's degree in 1651. Dr. Derham, whose brief 'Memorials,' published in 1760, are the chief contribution we yet have towards a biography of Ray, states that he was a good Hebrew scholar, an excellent orator, and, even in the early part of his Cambridge career, a student of Natural History ; whilst we have independent testimony to his skill as a tutor, and to the solid character of his preaching. It was then customary for sermons to be preached at Cambridge by graduates not in Holy Orders ; and Ray's 'Wisdom of God in Creation,' first published in 1691, his three discourses concerning the Dissolution and Changes of the World, and his funeral sermons on Dr. Arrowsmith, the predecessor

of Wilkins in the Mastership of Trinity, and on Mr. John Nid, a senior fellow, who assisted him in his botanical work, were thus delivered, though he was not ordained till 1660. These sermons entitle him to rank as the Paley, if not the Butler, of his age, as one of the chiefs of that school of Latitudinarian Theology, of which Hales and Chillingworth were the founders, and Burnet, Tillotson, and Butler the future exponents,—a school characterised "by their opposition to dogma, by their preference of reason to tradition, whether of the Bible or the Church, by their basing religion on a natural Theology, by their aiming at rightness of life rather than at correctness of opinion, by their advocacy of toleration and comprehension as the grounds of Christian unity."

Between 1657 and 1660 Ray was chosen to various honourable offices in his college, being Junior Dean in 1658, and Steward in 1659, and in December, 1660, in which month he was ordained both deacon and priest by Sanderson, Bishop of Lincoln. To this period belongs the first of those tours, mainly botanical in their object, of which we possess Ray's own diaries or itineraries. In August and September, 1658, he travelled alone through the Midland Counties and North Wales; and in 1660 appeared his first published work, the 'Catalogus plantarum circa Cantabrigiam nascentium,' a small duodecimo enumerating only 626 species in the alphabetical order of their Latin names, but marking an epoch in the history of British Botany, no less than in the life of its author. It was the first local catalogue issued in England, and is remarkable for the care with which the synonymy is collected from Gerard, Parkinson, the Bauhins, and others, for the notes on the uses and varieties of plants, the structure of the flower, &c., and for the descriptions of new species. Botany was at this date in the same empiric stage as that in which William Turner had found it in 1538: Gerard, Johnson, Parkinson, and others had published herbals, mere unsystematic catalogues of but roughly discriminated species from all parts of the world, with copious medical disquisitions, on their real or imaginary uses as drugs, gathered out of Dioscorides, or still more largely out of Dodoens' Flemish

works; but plants were considered merely as materia medica, and science of botany there was none. If we would gauge aright the services of Ray to this science alone we must compare such works as Bauhin's 'Pinax' (1623) or How's 'Phytologia' (1650) with Ray's 'History' (1686–1704) or the second edition of his 'Synopsis' (1696).

In 1661 Ray visited the south of Scotland, returning through Cumberland and Westmoreland, having with him his pupil, Mr. Philip Skippon; and in the following year, in company with his pupil and congenial friend, whose name will ever be associated with his own, Francis Willughby, who was seven or eight years his junior, he visited Wales and Cornwall, returning through the southern counties. His diaries of his three English tours were obviously not written by Ray with a view to publication; but they contain many interesting notes not only on Natural History, but also on archæological subjects.

The writer might now well have hoped for advancement in the Church, since his studies were becoming fashionable. The King "was himself a fair chemist, and took a keen interest in the problems of navigation. The Duke of Buckingham varied his freaks of rhyming, drinking, and fiddling, by fits of devotion to his laboratory. Poets like Denham and Cowley, courtiers like Sir Robert Murray and Sir Kenelm Digby, joined the scientific company," now mainly reunited in London. Wilkins in 1662 became rector of St. Lawrence Jewry; John Evelyn had returned from abroad, and settled at Sayes Court, Deptford; there was also "that prodigious young scholar, Mr. Christopher Wren," the nephew of the Bishop of Ely; and when, in April, 1662, the Royal Society received its charter of incorporation, Robert Hooke, who had been living as his assistant with Boyle, became its Curator of Experiments. As Mr. Green says, "The curious glass toys called Prince Rupert's drops recall the scientific inquiries which amused the old age of the great cavalry-leader of the Civil War. Wits and fops crowded to the meetings of the new Society. Statesmen like Lord Somers felt honoured at being chosen its presidents. Its

definite establishment marks the opening of a great age of scientific discovery in England. Almost every year of the half-century which followed saw some step made to a wider and truer knowledge." Flamsteed, Halley, Sydenham, Woodward, Grew, and, above all, Newton, are names which adorn the history of Science at this period. In Astronomy, in Medicine, and in Physiology as well as in Descriptive Botany and Zoology, mere empirical enumeration was rapidly giving place to the conception of Law. In the words of a recent and eloquent writer, "Natural Law is the last and most magnificent discovery of science. . . . . In the earlier centuries, before the birth of science, Phenomena were studied alone. The world then was a chaos, a collection of single, isolated, and independent facts. Deeper thinkers saw, indeed, that relations must subsist between the facts, but the Reign of Law was never more . . . . than a far-off vision. Their philosophies heroically sought to marshal the discrete materials of the universe into thinkable form, but . . . . with Copernicus, Galileo and Kepler the first regular lines of the universe began to be discerned. When Nature yielded to Newton her great secret, Gravitation was felt to be not greater as a fact in itself than as a revelation that Law was fact. And therefore the search for individual Phenomena gave way before the larger study of their relations. The pursuit of Law became the passion of science. What that discovery of Law has done for Nature, it is impossible to estimate. As a mere spectacle the universe to-day discloses a beauty so transcendent that he who disciplines himself by scientific work finds it an overwhelming reward simply to behold it. In these Laws one stands face to face with truth, solid and unchangeable. Each single law is an instrument of scientific research, simple in its adjustments, universal in its applications, infallible in its results."

Dryden the poet-laureate, who became a Fellow of the Royal Society in November, 1662, could only faintly have appreciated this when he wrote his apostrophe to the Society,—

> "Who best your wise Creator's praise declare,
> Since best to praise his works is best to know.
> O, truly Royal! who behold the *law*
> And rule of beings in your Maker's mind,"

in his 'Annus Mirabilis,' 1666.

But one month, however, after the incorporation of the Royal Society, Charles signed the "Act of Uniformity," by which two thousand conscientious clergy were deprived of their livings. It was not that Ray, or many others among them, were either Presbyterians or had taken the Covenant, for Ray frequently expressed his disapproval of that oath and of separatists, and declared on his death-bed that he died, as he had lived, a priest of the Church of England,—a fact alluded to in his epitaph,—but he declined to swear, as required, that the oath of the Covenant was not binding on those who had taken it. Ray accordingly, with twelve others, resigned their fellowships, and abandoned all hope of clerical preferment.

In 1663 Ray issued a small appendix to his Catalogue of Cambridge plants, and in the spring set out with Francis Willughby, Philip Skippon, and Nathaniel Bacon, three of his pupils, for a tour on the Continent, where he remained for three years, visiting France, Holland, Germany, Switzerland, Italy, Sicily, and Malta, a journey of which he afterwards rendered an ample account.

We fortunately possess a large series of Ray's letters, some of which have been printed in an incomplete form by Dr. Derham and Dr. Lankester; but the manuscripts of most of which are in the British Museum; and from them we can gather many details as to Ray's life after leaving Cambridge. In 1666 he seems to have visited his friend, Dr. Martin Lister, the well-known zoologist, at St. John's College, Cambridge, of which he (Lister) was a fellow, and then to have been at his native place and with friends in Sussex, and to have read Hooke's 'Micrographia,' Sydenham on Fevers, and various works by Boyle and others that had appeared during his absence abroad. In the winter of the same year he seems to have been with Willughby at Middleton, in Warwickshire, arranging his collections, and, with his assistance,

drawing up the synoptical tables of plants and animals for Dr. Wilkins' 'Essay towards a Real Character and a Philosophical Language,' published in 1668. These tables are of great importance, since they are the germs of all his subsequent systematic work, to which he mainly owes his pre-eminent rank in science. At the same time he was engaged in drawing up a general catalogue of the plants which he had seen wild in England, though he had no immediate intention of publishing it, since, as he writes to Lister, the world was "glutted with Dr. Merrett's bungling Pinax," this much-abused book having appeared in 1666.

In June, 1667, Ray and Willughby set out on a second visit to the south-western counties, and on their return to London, Ray was persuaded to become a Fellow of the Royal Society, to which he was admitted on November 7th. Soon after this he was persuaded, owing to the generally known beauty of his Latinity, to translate Wilkins' 'Real Character' into Latin; but the translation has never been published. He then went on a round of visits to his former pupils, and, in the autumn of 1668 on a tour into Yorkshire and Westmoreland, returning in September to Middleton Hall to spend the winter with Willughby, then newly married.

In the spring of 1669 these two congenial companions conducted a series of most useful experiments upon the motion of the sap in trees, especially in the Birch and Sycamore, which were printed in the fourth volume of the 'Philosophical Transactions' (1669). At the same time Ray prepared for the press two independent works, more important than his caution had permitted him to issue before his forty-third year, his 'Collection of English Proverbs' and his 'Catalogus Plantarum Angliæ.' The first of these works, one result of his English tours, has gone through repeated editions, and is still the basis of our existing collections; but the 'Catalogue of English Plants' is yet more important, being, with the exception of How's 'Phytologia Botanica,' published twenty years before, the first work that can in any way be called an English Flora. How enumerated 1200 species, and Merrett in his 'Pinax' (1666) upwards of 1400;

whilst Ray's list, in which neither cryptogams nor grasses were as yet numerous, only distinguishes 1050; but, whilst many of the supposed species of How and Merrett have never been identified, those of Ray are well known to all botanists who have taken the trouble to investigate the treasures of the Sloane Herbarium in the British Museum. Though only alphabetically arranged, this Catalogue must have superseded all others.

Without stopping to notice all the short papers contributed by Ray from time to time to the Royal Society's 'Transactions,' it is interesting to note that he expressed his disbelief in the then prevalent opinion of spontaneous generation.

In the autumn of 1671 he started for another tour in the north, taking with him Thomas Willisel, an uneducated man, who was, however, of great use not only to Ray, but to many of the other naturalists of the day, from his skill as a collector. But a few months later an unexpected event altered the whole tenour of the naturally unsensational life of a student such as Ray, *viz.*, the death of his young friend Willughby, then only in his thirty-seventh year, from a fever, in July, 1672; and not many months later, in November, Ray lost another great friend in Bishop Wilkins. His friendship for his pupil Willughby had always been of the most cordial character; it has, in fact, but one parallel in the history of science, and that a curiously close one, first pointed out by Dr. Lankester, the friendship of Linnæus for the ill-fated Artedi, who was drowned at the age of thirty. Both young men curiously left works upon Ichthyology, which were published by their surviving friend; but, in the words of Sir J. E. Smith, "from the affectionate care with which Ray has cherished the fame of his departed friend, we are in danger of attributing too much to Willughby, and too little to himself." Willughby bequeathed to his friend the care and education of his two sons, Francis and Thomas, the youngest of whom alone survived to manhood, becoming Lord Middleton. There was also a daughter. who became Duchess of Chandos, and the eldest child was then under four years old.

Willughby also settled an annuity of £60 a year upon Ray, which seems to have been his main income for the last twenty-seven years of his life; and he accordingly took up his residence at Middleton Hall, where, on June 5th, 1673, he married Margaret Oakeley, who assisted him in teaching the children, and, though twenty-five years his junior, made him a faithful wife, surviving him for some years.

In this same year, 1673, he issued an account of his continental travels, with a valuable catalogue of the plants observed which differed from those of England. Many of these had not previously been described by continental botanists. This work is, however, equally interesting from a digression it contains on British and foreign localities for fossils, and the various opinions as to their origin, in which Ray unhesitatingly declares against the theory of a plastic force, and expresses his belief in their organic origin. He drew up a tri-lingual Dictionary or Nomenclator Classicus, for the use of his pupils; and, whilst busily engaged in arranging and completing the materials left behind by his friend, issued in 1674 a most interesting 'Collection of English Words not generally used,' *i. e.*, of provincialisms, arranged in a northern and a southern series; to which he appended lists of English birds and fishes, and an account of the smelting of metals in this country.

By 1676 he had got ready for the press the 'Ornithology' left unfinished by Willughby, which was published in that year in Latin and in 1678 in English, both editions containing copper-plates engraved at the expense of Mrs. Willughby. On the death of Lady Cassandra Willughby, the mother of his friend, in 1676, his pupils were taken from Ray's care, and he removed to Sutton Coldfield, about four miles from Middleton, and thence, at Michaelmas, 1677, to Falkbourne Hall, near Witham, not far from Black Notley, where his mother was still living. She, however, died in March, 1678, which, perhaps, led to Ray's final settlement at his native place. Though he brought out a new and enlarged edition of his 'Catalogus Plantarum Angliæ' in 1677, and Willughby's 'Ornithology' in Latin in 1678, these removals

seem to have hindered his work; for his unceasing industry and marvellous productiveness are not the least proofs of the genius of this great man.

Not till 1682 have we any other work from his pen; but to that year belongs the first edition of the 'Methodus Plantarum nova,' one of the corner-stones of his philosophical fame. It was an expansion of the tables he had drawn up for Dr. Wilkins in 1668; and in it he describes the true nature of buds, speaking of them as annual plants, springing from the old stock; and recognises the important division of flowering plants into Dicotyledones and Monocotyledones, and many of the natural orders, such as Umbelliferæ, Stellatæ, Boraginaceæ, Labiatæ, Pomaceæ, Cruciferæ, Leguminosæ, Palmaceæ, and Coniferæ, of which we now make use. Above all, basing his system largely upon the fruit, but also in part now upon the flower and now upon the leaf, he made the first thorough step towards the establishment of a natural system of classification; and his arrangement (which was too far in advance of his time to be much appreciated, and was soon temporarily overlooked by the enthusiastic followers of the artificial system of Linnæus), in the words of Dr. Lindley, "when altered and amended, as it subsequently was by himself at a later period, unquestionably formed the basis of that method which under the name of the system of Jussieu is universally received at the present day." From a too conservative spirit of caution he at this time retained the old division into trees, herbs, and shrubs, and made the unfortunate mistake of denying the existence of buds on herbaceous plants; but while in the second edition, in 1703, he reduced these divisions into the two of woody and herbaceous plants, he only retained these out of deference to established usage. He acknowledges his indebtedness to Cæsalpinus, who preceded him by a century, and whom he styles the "parent of system"; but, if Cæsalpinus was the Wiclif of this Reformation, Ray was its Luther.

In 1685 he was able, mainly by the help of his friend Mr. Dent, to issue a small appendix to his Cambridge Catalogue; but the death in 1683 of his fellow-student of system, Robert

Morison, Professor of Botany at Oxford, redirected his attention to an ambitious scheme previously abandoned in his favour, *viz.*, the preparation of a general History of Plants, such as the Bauhins had attempted in the preceding generation. With wonderful rapidity he issued the first folio volume of this work in 1686, and the second in 1688, each containing nearly a thousand pages, the entire work being done without even the help of an amanuensis; and this in spite of the fact that from about this time for the remainder of his life he was troubled with most painful ulcers in his legs. To the first volume he prefixed a list of nearly 100 authorities, a glossary of terms, and a most comprehensive summary of all that had been done up to that date in vegetable histology and physiology, the researches of Grew, Malpighi, and others. Of this dissertation Cuvier and Dupetit Thouarø write, "We believe that the best monument that could be erected to the memory of Ray would be the republication of this part of his work in a separate form." His habitual caution is evinced by his only admitting Grew's discovery of the sexuality of plants as "probable," and the magnitude of the descriptive work achieved may be gauged from the fact that the two volumes enumerate about 6900 plants, as against 3500 in John Bauhin's 'History' of the year 1650. In the preface to the first volume of his 'Historia' Ray first mentions the assistance he had received from his neighbour, Samuel Dale, a young apothecary and physician living at Braintree, who during the great naturalist's later years occupied towards him much the same position that Francis Willughby had done fifteen or twenty years before.

In 1686, moreover, the Royal Society issued Willughby's 'Historia Piscium,' more than half of which was the work of Ray. Cuvier speaks of these, and of Ray's succeeding zoological works, as being "yet more important" than his botanical works, being "the basis of all modern Zoology."

Whilst contemplating a recasting of his 'Catalogue of English Plants,' now again out of print, into a systematic form, Ray in 1688 issued a small Fasciculus as an appendix to it; and in 1690 appeared that 'Synopsis Methodica

Stirpium Britannicarum,' which, after the 'Historia' and the 'Methodus,' forms the third laurel in his botanical crown, being, as it was, the first systematic English Flora, and not only remaining for many years the pocket-companion of every British botanist, but acting also as the model for many similar works. It is worth notice that in the Preface to this work Ray, who never said what he did not earnestly believe, thanks God and congratulates his country on the establishment of religion, law, and liberty by the Revolution of 1688.

In the following year, 1691, Ray issued, in an elaborated form, one of his earliest productions, 'The Wisdom of God manifested in the Works of the Creation,' which, as I have said, is considered by competent judges to entitle him to rank as a theologian with Paley and Butler. It was remarkably successful, having to be reprinted in the following year, and reaching eleven editions in about fifty years. In it he urges the study of Nature to be a pious duty, and one suited to a Sabbath day, and suggests the probability that it may be one of the main occupations of the endless Sabbath hereafter. He followed this work, in 1692, by his 'Three Physico-theological Discourses concerning the Primitive Chaos and Creation, the Deluge and the Dissolution of the World,' dedicated to Archbishop Tillotson, the curate, son-in-law and literary executor of his friend Dr. Wilkins. This work contains much interesting geological speculation, based upon a large number of carefully observed facts, and was also very successful, reaching a second edition in the following year, and a third in 1713.

In spite of increasing age and infirmity, at the urgent suggestion of his friends, and particularly of Dr. (afterwards Sir) Tancred Robinson, that he should undertake a Fauna Anglica and a History of Fossils, he did, at the age of 66, undertake a Synopsis of Quadrupeds and Serpents, which appeared in June, 1693, having been apparently completed in a year, and of which Dr. Pulteney says, "In this volume we see the first truly systematic arrangement of animals since the days of Aristotle." His classification is based upon the digits and the teeth, distinguishing the Solidungula, Rumi-

nantia, Pachydermata, Proboscidea, and Primates, not under these names, but very much as those orders are now limited.

Ray next set to work to arrange a Synopsis of Birds and Fishes, which, however, though finished by February, 1694, was laid on one side by the publishers until 1713, when it was issued under Dr. Derham's supervision. In this work he has added many species to the Histories prepared previously from Willughby's notes, and it is highly commended by both Cuvier and Brisson. In it he classifies birds by the beak and claws, the webbing of their feet, and the nature of their food; and, though he includes whales among fishes, he expressly explains, in a letter to Dr. Tancred Robinson, that he does so only in deference to custom.

Whatever he undertook, Ray could never perform any work in an incomplete or perfunctory manner. Accordingly, when Dr. Hans Sloane, having read with interest Dr. Rauwolf's account of his eastern travels, published in 1583, had a translation of them made, and placed it in Ray's hands for revision, the result was a work in two volumes, embodying all that was then known of the Levant, with a catalogue of the plants then known as growing there, which was, however, subsequently much added to, from Rauwolf's herbarium, in Gronovius's 'Flora Orientalis.'

His attention being thus turned, in compiling his 'Collection of Travels,' once more to exotic plants, Ray next proceeded to recast, in a systematic and much extended form, the catalogue of continental plants which he had appended in 1673 to his own volume of travels. This appeared in 1694 as 'Stirpium Europeanarum extra Britannias nascentium Sylloge,' though it includes the flora of Egypt and the Levant. In the Preface to this work Ray, for the first time, entered into controversy, criticising unfavourably the classification of plants published in 1690 by Rivinus, based upon the flower alone.

About the same time he was engaged upon the county lists of plants that appeared in 1695 in Gibson's edition of Camden's 'Britannia,' all of which were from his pen, with the exception of Middlesex, which was supplied by his friend

James Petiver; since, during his long life, our Essex naturalist had been but little in the metropolis, or the country adjoining it.

Between the publication of his 'Catalogus' in 1670 and that of the 'Synopsis' in 1690, 250 species had been added to the 1050 recorded species of the English flora; but in the following six years, 1690–1696, the accessions had been even more numerous, so that the second edition of this standard work, which appeared in the latter year, was considerably augmented, containing 1600 species. It had also an important letter from Rivinus, with Ray's answer thereto, replying to the criticisms of Tournefort, appended to it, and, containing a vastly more complete list of cryptogamic plants, it marks in an emphatic manner the far greater progress which Botany, thanks to Ray's labours, had made in England during thirty years than in other countries. At the same time as this second edition of the 'Synopsis' he issued a short Dissertation on various classifications of Plants, preparatorily to the revision of his 'Methodus,' which he completed by 1698. In this work he regrets his inability to visit London herbaria or botanic gardens, owing to his increasing infirmities; but he not only appends an important classification of grasses, sedges, and rushes to the work of 1682, but also improves it in various other ways, as, for instance, in abolishing the separation between trees and shrubs. This work was, however, refused by the London publishers, and was ultimately printed in 1703 at Leyden, under the supervision of his friend Dr. Hotton, Professor at that University, though the printers, contrary to Ray's directions, fraudulently put London upon the title-page.

Being now 73 years of age, and kept ever mindful of his end by painful diseases, this truly pious man devoted part of his time and fast-failing health, which prevented his walking beyond the limit of his own garden, to the preparation of a small devotional volume, 'A Persuasive to a Holy Life,' which was published in 1700; but, as his life was prolonged, idleness continued impossible to him, and, sixteen years having elapsed since the publication of the second volume of the 'Historia,'

he was induced to undertake, and lived to complete, a third and supplementary volume. This equalled in bulk the preceding volumes, and from the collections of Sloane in Jamaica, of Father Camelli in the Philippines, of Petiver, and others, included no less than 11,700 species, bringing the total of the entire work up to over 18,000 species. For these three folios, of nearly 1000 pages each, Ray received £30 each, or about threepence a page.

With invincible energy, when 76 years of age, he turned his attention to the classification of insects, some classes of which he had carefully studied in former years in conjunction with his friend Dr. Martin Lister; and he died, as a naturalist might well wish to die, in the midst of his work, on January 17th, 1705. In the British Museum there is still preserved, in his own neat handwriting, the touching farewell letter which he wrote to Sir Hans Sloane, in the middle of which his strength failed him, and he was forced to end abruptly: in Dr. Derham's edition of his Letters, published in 1718, is included his dying confession of faith made to the vicar of his parish, and from his own letters to Sloane we learn that his disciple, Samuel Dale, to whom he gave all his collections, was with him a few hours before his death. He was buried, according to his own request, in the churchyard at Black Notley, near his ancestors, having declined a tomb in the chancel, offered him by the vicar; and, though the monument erected over his grave has been repeatedly restored at the expense of scientific men, of him it may be said with peculiar truth that the best monuments of his life of unceasing devotion at the shrine of Nature are those works which, if they ever cease to be read, can never cease to bear fruit in the continued advance of Science along the sure road which he first sketched out.

His 'Methodus Insectorum,' in which he divides them virtually into the Metabola and Ametabola, was issued in the year after his death, and was afterwards prefixed to the 'Historia Insectorum,' published in 1710, under the editorial care of Dr. Derham, then rector of Upminster. This completes the lengthy list of the contributions to science and

literature of one of whom it has been said that he became, "without the patronage of an Alexander, the Aristotle of England, and the Linnæus of his age."

I would submit, however, that even this is not due justice to this hero of science; since, though it cannot be urged that he occupies a position in the history of philosophy approaching that of Aristotle, yet as a zoologist he was infinitely the superior of the ancient Greek naturalist; whilst, preceding Linnæus by nearly a century, he not only established a natural, as distinguished from a merely artificial, system of classification for both plants and animals, but may be truly said to have been the first to recognise the paramount importance of system, not merely for purposes of reference, but as representing natural relationships.

The memory of John Ray is thus adorned with the triple laurel crown of botanist, zoologist, and theologian, and as such should be honoured as one of the glories, not of Essex only, but of England and of the whole world of Science.

[Prof. Boulger is preparing a complete bibliographical catalogue of all Ray's works, with notes on the various editions, which will form an appendix to the above paper. This catalogue will probably be printed in a future part of the 'Transactions.']

XIV.

Notes on the Evidence bearing upon British Ethnology.[1]

By T. V. Holmes, F.G.S., M.A.I., &c.

[Read January 30th, 1886.]

The evidence bearing upon the character, affinities, and survival in our present population of the various groups of people that have from time to time settled in the British Isles still leaves much to be desired, though additions to it continue to be made by the practical explorer of prehistoric monuments, the comparative philologist, and the student of laws, manners, customs, and folk-lore. But the inconclusiveness of much of the available evidence, and its extremely varied nature, tend to cause an unusual amount of diversity of opinion among the ablest writers on this subject. For, as we all know, ability and learning do not necessarily exempt men from a tendency to overrate the importance of their own special branch of study and to underrate those of others; while ethnological prejudices are usually proof against any evidence not of the most overwhelmingly conclusive character. In setting before you this attempt at a review of the evidence at present available, it seems best to consider in the first place what is known or conjectured as to the characteristics and race-affinities of the various settlers in the British Isles, and in the second the extent of their probable survival at the present day.

British Palæolithic man need not detain us long. Though his implements have been found in bone-caves and old river-drift, no bones of Palæolithic man have yet been discovered in Britain, and Professor Boyd Dawkins remarks that the fragmentary condition of those found in Western Europe

[1] [This paper formed the Presidential Address at the Annual Meeting on January 30th, 1886. The introductory observations will be printed in the 'Proceedings' under the above date.—Ed.]

forbids any speculation as to the race to which they belonged. He is, however, inclined to consider the cave-man of Britain and Western Europe to be represented at the present day by the Eskimo, on account of the unusual aptitude, common to both races, of reproducing animal forms on their implements and ornaments, a talent not found in Neolithic man. This view is opposed by Prof. Flower,[2] who states that the Eskimo are such an intensely specialised race "that it is probable that they are of comparatively late origin, and were not, as a race, contemporaries with the men whose rude flint tools found in our drifts excite so much interest and speculation as to the makers." He adds that the Eskimo have evidently been derived from the same stock as the Japanese. And when we turn to illustrations given by Prof. Boyd Dawkins of Palæolithic and Eskimo drawings[3] we cannot fail to notice that the artistic aptitudes of Palæolithic man were far superior to those of the Eskimo of our own day. The presumption therefore seems to be against Prof. Boyd Dawkins's view. No pottery of Palæolithic age has yet been discovered. With the negative conclusion that we know nothing of the racial affinities of British Palæolithic man, I pass on to his Neolithic successor.

Of Neolithic man the remains are both more numerous and more important. In many parts of Britain barrows exist, containing not only his indestructible flint-implements, but occasionally his pottery and even his bones. These barrows are especially numerous on the Yorkshire Wolds and on Salisbury Plain, and many of them in various parts have been explored by Sir Richard Colt Hoare, Bateman, Thurnam, Greenwell, and other investigators. Their researches tend to show that the small long-headed (dolicho-cephalic) Neolithic people, the remains of whose chiefs are found in British long barrows, once spread over the whole of our islands, and that they are well represented among us at the present day, though usually more or less modified by succeeding races. Most writers are inclined to think the shorter and darker

[2] Journ. Anthrop. Inst., vol. xiv., pp. 387-8 (May, 1885).

[3] 'Early Man in Britain,' pp. 216, 217, 221, 238, 239.

part of our present population to be not only largely a survival from Neolithic times, but to be akin to the Iberian element of South-western France and North-western Spain. One of the latest and ablest, however, Mr. Elton, considers that the evidence for this view is insufficient, inasmuch as we find no traces in this country of the exaltation of women above men, and of the strange custom of the Couvade, which still prevails among the Iberians. This custom of the Couvade, however, is not specially Basque (or Iberian), but is found among certain tribes of North and South America, India, and other parts of the world, having apparently originated independently in various countries. And while its co-existence in the neighbourhood of the Pyrenees and among Britons of the Silurian type would have gone far to establish affinity of race, its absence from Britain is by no means testimony equally strong against affinity. For the Basque language is still spoken by a considerable number of persons on both sides of the Pyrenees, but no pre-Celtic tongue has been spoken in Britain for many centuries, though comparative philologists tell us that the British Celtic languages show undoubted signs of having been influenced by older forms of speech now extinct. And it is but natural that the influences which have wholly extinguished pre-Celtic languages should also have swept away pre-Celtic customs, which are found where the pre-Celtic tongue has been preserved. Besides, as regards the Iberian reverence for woman, we must also remember that to a race invading Britain at a later date we owe the popular rhyme :—

> "A woman, a dog, and a walnut tree,
> The more you beat them the better they be,"

which discloses a way of regarding woman very different from that of the ancient Iberians.[4]

I have stated that the remains of British Neolithic man are found in long barrows. These long barrows are considered by Canon Greenwell to be the earliest sepulchral

[4] Mr. Metcalfe, in 'The Englishman and the Scandinavian,' remarks, p. 147, "Singular to relate, woman's love is nowhere described in extant Anglo-Saxon poetry."

mounds to be found in Britain. They have never been known to contain any metal but, very rarely, gold; but little pottery and no broad-headed (brachycephalic) skulls have ever been found in them. The long barrows of Britain appear, as regards the absence of metal in each, to be represented in Scandinavia and Western France by chambered mounds, both long and round in form, in which the dead are interred in chambers, not in cists. But while the British long-barrows contain only long-headed (dolicho-cephalic) skulls, the skulls of the Scandinavian mounds are mainly broad-headed (brachycephalic), and those of the barrows of Western France are of both forms, in almost equal numbers.

Neolithic Britain appears to have been invaded by a people who buried their dead in round barrows, and who, though broad-headed, like the Scandinavians of the chambered mounds, were unlike them in being acquainted with the use of bronze. In these round barrows pottery is much more abundant than in the long barrows. On the whole the new-comers seem to have mingled peacefully with the Neolithic people, skulls of both races being found in the round barrows. These bronze-using people were very unlike the Neolithic race, being taller, stronger, and much rougher in appearance, with large frontal sinuses and supra-orbital ridges, prominent cheek-bones, and heavy jaws. So far as the evidence goes it seems to point towards the identity of this Bronze people with the Finnish or Ugrian stock. The late Prof. Rolleston remarks[5] that the "Briton of the round-barrow period all but certainly presented much the same combination of physical peculiarities as the modern Finn and Dane"; and he adds:—"The bronze-period Briton very closely resembles in his osteological remains the brachycephalous Dane of the Neolithic Period, and the likeness between these and some of the modern Danes has been noticed by Virchow," &c. Mr. Elton[6] states that a Finnish idiom has been traced in several of the British (Celtic) languages; and we learn from Prof. A. H. Keane[7]

[5] 'British Barrows,' p. 680.

[6] 'Origins of English History,' chap. vii.

[7] 'Europe.' By F. W. Rudler and G. G. Chisholm. Edited by Sir A. C. Ramsay. Ethnological Appendix by A. H. Keane, p. 577.

that, though the five groups into which he divides the Finno-Tatar family differ a good deal in their physical characteristics, they are all alike brachycephalic. There is thus a strong probability that our invaders of the Bronze Age were men from what is now Denmark, but of Finnish and not Teutonic affinities.

Before treating of the Celtic peoples who succeeded the broad-headed man of the Bronze Age, it seems to me that a few words about the makers of the great stone circles and the builders of the lake dwellings should not be omitted. Of the great stone circles the most advanced, as regards construction, is Stonehenge, and for this reason we may infer that it is the latest in date. Sir John Lubbock notes that it is the centre of a very large number of barrows, these barrows dating evidently from the Bronze Age. We may therefore conclude that Stonehenge itself probably dates from the Bronze Age; also that the ruder stone circles, such as that at Abury, near Marlborough, that near Keswick, and "Long Meg and her daughters," in Cumberland, are most likely of still greater antiquity.

As regards lake-dwellings in the British Isles, it has been found that while many of our crannoges were originally formed in Neolithic times, there is also abundant evidence, in many cases, to show that they were still inhabited in Post-Roman times. Both stone circles and lake-dwellings are found in countries so remote from each other, and so diversely peopled, that there can be little doubt that they originated independently in many lands. In Britain both stone circles and lake-dwellings appear to have existed long before we have any evidence of a Celtic immigration.

Leaving the pre-Celtic peoples of the long and round barrows, we come to the Celtic races, who must have been settled here in considerable numbers long before the Roman occupation, since it is not known that any pre-Celtic languages were spoken in Roman Britain. To the Romans the Celts were a tall fair race. As regards the typical shape of the Celtic skull, it may be said to have been dolicho-cephalic. The late Prof. Rolleston remarks ihat "many authorities

may be cited for the proposition that the typical dolicho-cephalic Scandinavian is not to be distinguished from the typical dolicho-cephalic Celtic skull," and mentions Retzius, Sir William Wilde, Nilsson, Omalius d'Halloy, Virchow, and Schaafhausen as holding this view, though he himself appears to think they differ in certain minor details.[8] He also quotes from Broca[9] to the effect that certain districts of modern Brittany, in which refugees from Britain in the 5th century are said to have settled in great numbers, are now distinguished by the tallness, light complexion, and dolicho-cephaly of their inhabitants.

Both branches of the Celtic family, the Briton (Brython) and the Gael (Goidel), are represented in the British Isles. The Gael appear to have been the earlier comers, both from the position of the Gaelic-speaking people at the present day, and from traces of their former existence where the language of the other branch of Celts is now spoken. On the Continent Gaelic is unknown, while a tongue akin to Welsh is still that of a million and a half of Frenchmen in Brittany. Like almost all the invaders of Britain, there can be no doubt that both Gael and Briton first landed in the south-east, and thence spread towards the west and north. The Gaelic colonists are consequently found still speaking their language in Ireland and the Highlands of Scotland, while the language of the Britons prevails in Wales, and existed, little more than a century ago, in Cornwall. Mr. Isaac Taylor remarks that the greater number of Celtic names in England are of Brythonic type, but notices the existence of a thin stream of Goidelic names from the Thames to the Mersey, "as if to indicate the route by which the Gaels passed across to Ireland, impelled probably by the succeeding hosts of Cymric invaders."[10] On the other hand, there appears to be little evidence, judging from place-names, that any considerable number of Brythons crossed over to Ireland, though Brigantes settled in what is now Wexford. But they predominated in Britain south of the Forth and Clyde, and settled more or

[8] 'British Barrows,' p. 646. [9] 'British Barrows,' p. 636.
[10] 'Words and Places.'

less on the eastern coast of Scotland, as far north as Aberdeen. Mr. Taylor remarks that the words *inver* and *aber*, which both mean a confluence of waters, are useful test-words in discriminating between the two Celtic families, *inver* being the Gaelic word and *aber* the Brythonic. And he notes that if we draw a line from a point a little south of Inverary to another a little north of Aberdeen, we shall find that, with a few exceptions, the *invers* lie north-west of the line and the *abers* to the south-east of it.[11] In Ireland he remarks that the Erse or Gaelic word *bally*, a town, occurs in 2000 names, while it is unknown in Wales and Brittany. And in Scotland *bally* abounds in the *inver* district, while it is extremely rare among the *abers*. But, though these test-words probably give a true notion of the amount of territory over which Brythonic influence prevailed, it must be remembered that we can learn nothing from them or other language tests as to the proportion of Brythons, by race, to Goidels and pre-Celtic peoples, in the districts speaking a Brythonic tongue.

In the middle of the 4th century, B.C., Britain was visited by the famous explorer Pytheas,[12] whose expedition was fitted out by the Greek merchants of Marseilles with a view of enabling them to open out a trade in tin and amber with the northern nations. Pytheas does not seem to have visited Western Britain. In the south-east he saw an abundance of wheat in the fields, and notices the necessity of threshing it out in covered barns on account of the rainy climate. After the return of Pytheas a trade appears to have been opened between Britain and the Continent, not between Cornwall and Brittany, but between Kent and the nearest part of Gaul.

Mr. Elton remarks that the Celts may have brought in the knowledge of iron and silver: the continental Celts being known to have used iron broadswords at the battle of the Anio in the 4th century B.C. (361 B.C.), and iron having been worked in Sussex by the Britons in the time of Julius Cæsar.

[11] Mr. Skene ('Celtic Scotland,' vol. i., p. 221) differs to some extent from Mr. Taylor as to the distribution of *inver* and *aber*. Also on that of *pen* and *ben*.

[12] See Elton's 'Origins of English History,' chap. i.

But he adds that it will be safer to assume that the British Celts belonged to the later Bronze Age, as well as the Age of Iron. It is also necessary to remember that bronze would remain in use for many purposes after the introduction of iron, and that iron articles deposited in tumuli must have often perished while bronze ones have endured.

More than two centuries after the voyage of Pytheas, Britain was visited by an eminent Greek named Posidonius, who gave some account of the people of Belerion or Cornwall and their tin-works. Posidonius is supposed to be the authority of Diodorus Siculus for the statement that the people of Britain had mean habitations, made for the most part of rushes and sticks, and that their harvest consisted in cutting off the ears of corn and storing them in pits underground, some of the corn which had been longest stored being taken out each day for food. As Pytheas confined his explorations to Eastern Britain, it is not surprising that he found a more advanced civilisation there, where there was constant intercourse with the Continent, than Posidonius did, two centuries later, in parts of the west little visited by merchants. Posidonius, however, remarks that the inhabitants of Belerium are very fond of strangers, and, from their intercourse with foreign merchants, are civilised in their manner of life. But, of course, the most primitive habits might exist a very few miles away from the commercial centres and routes, alike in the east and the west.

In B.C. 55 and 54, some thirty or forty years after the visit of Posidonius, the two voyages of Julius Cæsar to Britain took place; and we learn from his remarks on the reasons for visiting our island how little was known about it in Gaul.[13] Cæsar had been annoyed to find that in the wars of the Romans with the Gauls the latter were accustomed to receive help from Britain. He also found that merchants who had been in the habit of crossing over to Britain knew but the sea-coast and the parts opposite Gaul, and could tell him neither the size of the island, the numbers of its inhabitants, nor anything about their manners and customs, their modes

[13] 'De Bello Gallico,' Book iv., ch. 20.

of making war, or the positions of their best harbours. In the account of his second voyage he remarks,[14] that in the interior of Britain live the descendants of the original inhabitants, while the parts near the coast are inhabited by those who have crossed over from the land of the Belgæ. Of course the coast referred to is that of the south-east. He adds that the most civilized of all these nations are those which inhabit Kent, whose customs are similar to those of the Gauls. The tribes of the interior were either pre-Celtic, or Gauls who had settled in Britain many generations before the voyages of Cæsar.

Little can be said about the race-affinities of the various tribes found here by the Romans during their occupation. The fullest discussion of this question, from the philological point of view, may be found in the late Dr. Guest's 'Origines Celticæ.' The following examples, however, may be given. The Silurians of South Wales are generally allowed to have been largely pre-Celtic or Iberian, their dark complexion and curly hair having been noted by Tacitus. Mr. Elton considers the Ordovices of central Wales to have been a nation of Gaelic descent, and Professor Rhys supposes the Damnonii, or Dumnonii, of Cornwall, Devon, and Somerset, and the Durotriges of Dorset to have been mainly Gaelic. Dr. Guest is inclined to think there was a connection between the Brigantes, Coritani (or Coritavi), and Iceni, and the Lloegrian or Ligurian group of the Brythons. But the Iceni are considered by Mr. Elton to have been mainly of the more recent Gallic immigration to which the Cantii, Trinobantes, and Catyeuchlani belonged. As regards the Belgæ, who, as Cæsar remarks, settled in the maritime parts, and who occupied a considerable territory in what are now Hampshire and Wiltshire, they are considered by Dr. Guest to have been a Gaelic people.

A general ethnological survey of the British Isles at the time of the Roman Occupation would have given the following broad results. In Ireland the population mainly consisted of a dark pre-Celtic race, probably Iberian, with a later and

[14] 'De Bello Gallico,' Book v. ch. 12.

fairer Gaelic immigration. In Scotland the same Iberian people, with a large Gaelic admixture, occupied the Highlands, while the Lowlands were inhabited by races among whom the Brythons were the prevailing influence. In what is now England the Brythons were almost everywhere paramount. It does not appear that the broad-headed men of the Bronze Age anywhere formed a distinct and separate element of the population.

Here the question suggests itself, Who were the Picts? The prominence ot this people during the Roman Occupation and their utter disappearance, as a nation, shortly after, have naturally given rise to many conjectures as to their ethnological affinities. Of these speculations the most probable seems to me to be that of Professor Rhys, who thinks that the Picts, though by no means a pure and unmixed race, were mainly composed of the dark pre-Celtic people, the Scots being chiefly Goidelic. According to Professor Rhys,[15] the true story of Macbeth has an ethnological interest it is not generally supposed to possess. Macbeth, when he slew Duncan in the year 1040, was the head of the Transmontane Picts, and bore the title of Mórmaer or grand steward of Moray. He was thus, in a sense, the representative of the old line of Pictish kings which had been superseded by a Gaelic dynasty. The exact circumstances under which Macbeth slew Duncan are unknown, but it was probably the result of an attempt on the part of Duncan to reduce Macbeth to submission. Macbeth reigned as King of Alban, or Scotland beyond the Forth, seventeen years, and was then slain in battle by Malcolm, son of Duncan, the representative of the Gaelic line of kings. Still later, in 1160, we read of severe measures being taken to reduce the people of Moray to obedience. And when we find, as will be presently shown, that the dark-haired people of Scotland are especially numerous in the former head-quarters of Macbeth's power, the ancient districts of Moray and Buchan, it seems to me clear that Professor Rhys's view is most in harmony with the available evidence.[16]

[15] 'Celtic Britain.'

[16] Mr. Skene is inclined to think the Picts Gaelic; Mr. Isaac Taylor, Brythonic.

This explanation, I may here remark, gives a significance to a statement of Sir Walter Scott's, in 'Waverley,' which it would not otherwise possess. In describing the march of the Highland army from Edinburgh to the fight at Prestonpans, he notes, after describing the fine, well-equipped men in front, that among the ill-armed and wretchedly accoutred peasants in the rear were many who claimed to be of more ancient descent than the masters they served. Every important clan, he remarks, had some of these Helots attached to it;—"thus the MacCouls, though tracing their descent from Comhal, the father of Finn or Fingal, were a sort of Gibeonites or hereditary servants of the Stewarts of Appin; the Macbeths, descended from the unhappy monarch of that name, were subject to the Morays, and clan Donnochy or Robertsons of Athole."

One of the Welsh Triads, according to Dr. Guest,[17] describes the people whom we have hitherto called Britons or Brythons, the predominant race of Roman Britain, as themselves composed of three closely allied tribes, the Cymry, Lloegrians and Brythons. Dr. Guest remarks that the name Cymry is unknown to the Breton language, and is known in Cornish only as indicating the race of our modern Welshmen. It must, however, have also been borne by the people of Cumberland, the district from the Lake Country to Clydesdale. The second tribe, the Lloegrian, is said to have come from Gascony, and Dr. Guest inclined to think them identical with the Ligurians. Dr. Beddoe[18] also thinks it probable that the Lloegrians partook somewhat of the blood of the Ligurian, or Celtic, or Arvernian stock prevailing in the centre and south of France, and which is there thick-set, dark, and broad-headed. I have already mentioned that Dr. Guest, on philological grounds, is inclined to think the Brigantes, Coritani, and Iceni belonged to this Ligurian division. The Brythons, the latest of the three tribes, according to the Triad, to land in Britain, appear to have come from Northern Gaul, and naturally settled chiefly in the south and south-east. And as all direct intercourse with the continent was

[17] 'Origines Celticæ,' vol. ii. pp. 7-9. [18] 'Races of Britain.'

confined to the Brythons, the inhabitants of our island became known to foreigners as Britons.

Roman Britain nearly coincided with Brythonic Britain. Its northern boundary was the Barrier of Antoninus Pius, which consisted of an earthern rampart having a deep ditch on its northern side and a military road on the south, and ranged from the Clyde, near Dumbarton, to Caeriden on the Forth. Much better known than the Barrier of Antoninus is the Wall of Hadrian, between Wallsend on the Tyne and Bowness on the Solway. From the Notitia Imperii we learn to what nations the troops that garrisoned the stations along this wall belonged towards the end of the fourth century. Each station was held by a cohort of infantry or an equivalent force of cavalry. The nations or tribes manning the stations when the Notitia was compiled were Lingones, Cornovii, Astures, Frisii, Batavians, Tungri, Gauls, Dalmatians, Dacians, Moors, Lergi, Spaniards, Thracians, Morini, and Nervii.[19] The absence of Britons by no means implies a want of respect for their military qualities, but in accordance with Roman policy it was felt that British valour was more sure to be exerted in a way useful to Rome if employed on the continent. It is evident also that fidelity to the Roman Standard, in a remote part of the empire like Hadrian's Wall, was the more assured by the small numbers of each nationality, which would prevent dangerous combinations among the various cohorts. When it is remembered that the veteran soldiers were settled on the public lands, it is clear that a very considerable number of foreigners of the most diverse races must have been introduced into Britain during the Roman Occupation from this source alone. But in addition to these military settlements, it was a common Roman custom, after a war, to export a certain number of families belonging to some warlike and troublesome nation to another country under Roman rule, and thus convert people, likely to become enemies on the first opportunity, into peaceful citizens, powerless for evil, and loyal because owing their lands to the Roman government. Many families

[19] Bruce's 'Handbook to the Roman Wall.'

from the frontiers of Gaul and Germany must thus have been exported into Britain, and many Britons have been settled on the continent, without any record of the event having come down to us. It is known, however, Mr. Seebohm remarks, that "deportations of tribesmen of the Alamannic group were repeatedly made into Britain."[20] It is thus obvious both that a very large number of foreign settlers must have been introduced into Britain during the nearly four centuries of Roman rule, and also that the settlers came from all parts of the Roman empire.

The next invaders of Britain, the Angles, Saxons, and Jutes, were, on the whole, a tall, fair people with oval skulls. They appear to have first landed here about the middle of the fifth century, soon after the withdrawal of the Romans. The Jutes are said to have settled in Kent and the Isle of Wight; the Saxons in Essex, Sussex, and Hampshire; and the Angles on the east coast from Suffolk to Northumberland. Landing in considerable numbers, and speaking a low-German tongue mutually intelligible, it is not surprising that they soon made themselves supreme over a considerable area of Britain towards the east and south coast, when we consider the care taken by the Romans to deprive the Britons of all power or wish to help themselves, and of all feeling of nationality. The documentary evidence bearing upon this invasion is very slight and unsatisfactory, the earliest work dealing with the subject being that of Gildas, who wrote in the middle of the sixth century, and whose work is rather a fiery sermon denouncing the vices of the Britons and their chiefs, than anything else. "The notions of Gildas," says Mr. Gáirdner,[21] "at least as to the order and succession of events, are exceedingly confused and inaccurate, nor are they in harmony with well-informed Greek and Roman writers as to the events themselves. But from the early part of the fifth century Greek and Roman writers tell us nothing of the affairs of Britain, and Gildas is the original authority used by Bede and succeeding writers as the basis of our early English history." Bede's 'Ecclesiastical History of the

[20] Seebohm, 'The English Village Community.'

[21] Early 'Chroniclers of Europe.'

English Nation,' is the next authority as regards date; it was written about 731, and Bede's death took place in 735. Then comes the Saxon Chronicle, which is known to have existed in the time of King Alfred, more than a century later, and may have been begun by him. In the words of Mr. Elton:[22]—"Of the (English) Conquest itself no accurate narrative remains. The version which is usually received is based in part on the statements in the histories of Gildas and Nennius, and in part on Chronicles which seem to owe much to lost heroic poems in which the exploits of the English chieftains were commemorated." He adds that Hengist, for example, is but a hero of song and legend; a hero of such numerous and such divergent traditions that he is ubiquitous, and fills all kinds of characters. In the fragmentary poem known as "The Fight at Finnisburg," Hengist leads a band of Jutish pirates to burn the palace of the Frisian king. In the legends of the Frieslanders themselves he is claimed as the father of their kings and as the builder of their strongholds on the Rhine.

On the other hand the Welsh accounts are equally unsatisfactory as materials for a history of the period, and the British hero, Arthur, and his exploits, are as impossible to localise with certainty as Hengist and his deeds. Dr. Guest thought that Arthur's great victory over the Saxons at Mount Badon was probably won at Badbury Rings, in Dorset, while Mr. Skene considers the position of this and the rest of Arthur's battlefields to have been in the Scottish Lowlands, where the number of Arthurian names is especially great. The site of the battle of Mount Badon, on this last hypothesis, is considered to be Bouden Hill, not far from Linlithgow. Again, the tradition of the Britons of Damnonia was that Arthur's burial-place was Glastonbury; while the Brigantes held that he lay enchanted under the Eildon Hills, or beneath the Castle of Sewingshields, close to Hadrian's Wall.

We gather, however, that, at all events, the Anglo-Saxon supremacy was attained very slowly, except in the counties bordering on the east coast, and that their progress suffered

[22] 'Origins of English History,' ch. XII.

a severe check about the year 520. In 633 we hear of an alliance between Cadwallon of Wales and Penda of Mercia against Edwin of Northumbria. About the year 777 Offa, the powerful King of Mercia, constructed the celebrated dyke which bears his name, and which was for centuries afterwards the boundary between England and Wales; and at the same time the Welsh princes removed their royal residence from Pengwern or Shrewsbury, which became an English town. In 813 Egbert of Wessex, who afterwards became overlord of the whole country south of the Forth, waged a successful war with the Devonian Britons, and fixed the boundary of independent West Wales at the Tamar. As regards the northern or Strathclyde Britons, we learn that the independent British territory, which about the year 600 included not only the western half of the Scottish Lowlands, the whole of Cuumberland, Westmoreland, Lancashire, and Cheshire, but also a considerable part of West Yorkshire and Derbyshire, and extended southward to Warwickshire, had been diminished in the ninth century by the loss of all the country south of the lake district. That part of the remainder which lay between Morecambe Bay and the Solway was conquered by Edmund the son of Athelstan, with the help of the king of South Wales, in the year 945, and given to Malcolm of Scotland. The Scottish kings appear to have held Cumberland till the year 1072, and to have unsuccessfully claimed its restitution, at intervals, from the kings of England down to the time of Henry III. It is interesting to note as a result of this specially late connection of Cumberland, among English counties, with Scotland, that natives of Cumberland, now living, who have found themselves classed as Scots by natives of other northern English counties, and have objected, have been told that anyhow they were *Cumberland* Scots. And, on the other hand, as a paragraph in the 'Carlisle Journal' of March 20, 1885 informs us, the Scottish borderers also recognise their former connection with the Cumberland people. Tradition states that the two bells in Bowness Church, on the Cumberland shore of the Solway, were stolen, one from Middlebie near Ecclefechan, the other

from Dornock near Annan. The present minister of Dornock wrote to the editor of the 'Carlisle Journal' stating that a similar tradition as to the stealing of the Dornock bell exists at that place. "During the last thirty-nine years," he says, "I have often heard old people speak of it as having been stolen by certain Englishmen, or as sometimes designated, 'Cumberland Scots.'"

The next invaders of the British Isles were the Scandinavians, a race, on the whole, tall and fair, with skulls generally of an oval shape. We have no record of any Swedish settlement in our islands, but the Danes appear to have settled largely in Yorkshire, Lincolnshire, Norfolk, Nottingham, and Leicester, while the Norwegians more or less occupied the Orkney and Shetland Isles, the coast of Caithness and Sutherland, and a considerable area of the western isles of Scotland. They also made settlements in Cumberland, Lancashire, and Pembrokeshire, and here and there on the north-east coast of Ireland.[23] The first landing of the Danes in England is said, in the Saxon Chronicle, to have taken place in the year 787. But their earlier expeditions were made entirely for the sake of plunder, and it was not till the year 866 that they invaded England with the view of conquering and colonizing a part of it. In 867 they conquered Northumbria, in 870 East Anglia, and in 874 Mercia, while in 871 they invaded Wessex. In consequence of the gallant resistance of the great West-Saxon king, Alfred, their progress was somewhat checked, but a few years later we find the Danes supreme in Wessex, and Alfred a fugitive. In 878, however, Alfred's victory at Edington was followed by the peace of Wedmore, by which treaty Danish rule was restricted to the country east of Watling Street, the Roman road from London to Chester. The victories of the son and grandson of Alfred, Edward, and Athelstan, had no permanent result, for in 941 we find Watling Street again fixed as the boundary of the West Saxon and Danish territory. In 1002 the massacre of the Danes of Wessex, by the order of the imbecile Ethelred, occurred, resulting in the flight of

[23] See map in Taylor's 'Words and Places.'

Ethelred to Normandy and the rule of Danish kings in England from 1013 to 1042.

The latest invasion of all, of a warlike kind, the Norman, must have added both to the fair and dark elements of our population. As regards race, the Norman army that fought at Senlac Hill was evidently much more French than Scandinavian, more Celtic than Teutonic. For the Normans composed but one of the three divisions of William's army, the two others consisting of French and Bretons. And the Normans themselves had been settled in Normandy since the year 912, where they had lost their language, through intermarriage with the natives, though they had at the same time given their name to a large province of France. The Norman invasion therefore, including therein the migration from Normandy to England which took place after the establishment of Norman rule, must have added considerably to the complexity, as regards physical appearance and moral and intellectual characteristics, already existing here. Though no new race was added, the Celtic and Scandinavian elements in our population were considerably strengthened by the Norman Conquest.

I now approach the second part of my subject, the discussion of the evidence bearing upon the extent of the survival in the English people of the present day of the various invaders that have been briefly mentioned. To begin with the evidence of lauguage. Professor Freeman and other eminent writers of strong Teutonic sympathies have been in the habit of insisting that the disappearance of Christianity, of the Roman laws and the British language consequent upon the invasion of the Angles, Saxons, and Jutes, together with the fact that our present language is fundamentally Anglo-Saxon, imply that the Romano-British population was, in the main, either extirpated or driven into Damnonia, Wales, or Strathclyde. And the massacre at Anderida, and one or two other similar events, have been cited in illustration of the Anglo-Saxon method of waging war in Britain. This view has naturally recommended itself strongly to inquirers from the philological standpoint, and, outside learned circles, its

simplicity, and its settlement of the question without leaving any need for further inquiry, have made it highly popular. It has not received the same favour from anthropologists, to whom language offers but one test of race, and that of by no means the most fundamental nature. However, fifteen years ago the philologists were generally considered almost the sole authorities on this question. Thus, when Professor Huxley, in January 1870, delivered a lecture on "The Forefathers and Forerunners of the English People," in which he remarked that "physical, mental, and moral peculiarities go with blood and not with language;" and, in combating the common anti-Celtic cant, said that a native of Tipperary was "just as much or as little an Anglo-Saxon as a native of Devonshire," an opponent in the 'Saturday Review' considered him to have taken up a subject not properly within his province! But in 1874 an eminent philologist, the Rev. A. H. Sayce, remarked in a discussion at the Anthropological Institute, that not only is "the philologist who makes language the test of race a bold man, but I would go further and say that language cannot be the test of race at all, but only of social contact." And in a paper illustrating this remark which appears in the same volume of the Journ. Anthrop. Inst. (1874) he says:—"As regards race, language will tell us nothing. It does not even raise a presumption that the speakers of the same language are all of the same origin. . . . Language shows that they have all come under the same social influences." It is thus obvious that language can only give a presumption as to race where evidence from the personal characteristics, &c., of a people is not in opposition to it. In the case of this country, however, anthropologists are generally of opinion that its inhabitants are much less Teutonic than their language.

Anglo-Saxon Britain being nearly identical in area with Roman Britain, it is certainly a note-worthy matter that while in Gaul the Roman language and religion lived on, they disappeared before the Teutonic invaders of Britain. But there was a considerable Greek and Roman intercourse with Gaul before it was conquered by Julius Cæsar, about

50 B. C.; while Britain, in Cæsar's time, was an island into which only a few Gaulish or other merchants had penetrated, and which was not completely overrun by Agricola before the year 84 A. D., or 134 years later. And Britain was abandoned by the Romans at an earlier period in the fifth century than that at which Roman authority came to an end in Gaul, which being a much larger country than Roman Britain, and in a more civilized condition, both absorbed its invaders more easily and became much more thoroughly Romanized than its northern neighbour. In addition, the invaders of Gaul in the fifth century were Burgundians, Franks, Visigoths, and Huns, people by no means so closely allied to each other either in blood or language as the Angles, Saxons, and Jutes. Thoroughly Romanized Gaul, therefore, maintained its Latin tongue against its varied invaders without difficulty; while in Britain, where the city probably spoke Latin, and the country people various British dialects, neither tongue had prestige enough to enable it to hold its ground against the speech of a mass of nearly homogeneous colonists. Similar reasons seem to me to explain the disappearance of Christianity in Eastern Britain, and its maintenance in Gaul; it is probable that the British country people were in the fifth century still mainly Pagan, while the cities of Britain had become Christian.

It is thus obvious that the change of language and religion gives no presumption that the change of race was of an equally fundamental character, but leaves the question perfectly open. For, as the case of Cornwall teaches us, a language may so increase a predominance originally slight as to be gradually accepted by a race, once speaking another tongue, without any corresponding change in blood accompanying its diffusion.

And as a language increases its ascendency and becomes the tongue of a larger and larger number of people alien in blood to its original speakers, they, on acquiring it, usually identify themselves with those whose language they have adopted, and often consider people much more really akin to them as a different race. Thus it has been noticed that no

people think themselves more thoroughly English than the inhabitants of English counties on the Welsh border; though the difference of race is almost imperceptible, the distinction of language decides the feeling of nationality.

The evidence of place-names also, though most interesting and valuable, is necessarily equally inconclusive as testimony to the relative proportions of the different races inhabiting a country. For example, the pre-Teutonic place-names in Britain south of the Forth are almost all of the Cymric or Brythonic family. Yet, as we have seen, there is evidence of the existence of two pre-Celtic peoples and of the Celtic Gaels in the same district prior to the advent of the Brythons, and there is conclusive evidence against the extermination of the earlier races by the Brythons. But the Cymry, Lloegrians and Brythons, known collectively by the latter name, doubtless spoke a tongue intelligible to each other, and their language naturally acquired the same advantage over the Celtic and pre-Celtic dialects, spoken when they arrived here, that the tongue of the Angles, Saxons, and Jutes obtained over the Latin and British dialects spoken here in the fifth century.

Thus neither the supremacy of the Brythonic tongue in Britain on the coming of the Romans, nor that of the Angles and Saxons some centuries after their departure, necessarily imply any considerable slaughter of the pre-existing races. On this point, as we have seen, our histories can tell us nothing. It has often occurred to me that we are too apt to forget that the period between the Anglo-Saxon invasion and the reign of Alfred (871–901) was as long as that between the Wars of the Roses and the present day, in other words a period of more than 400 years. Yet even in Alfred's time not only Cornwall and Devon, but Somerset and even parts of Wiltshire were still regarded as *Welsh*, the term implying not only that their inhabitants were of British race, but that a British tongue was still spoken there. Many centuries have elapsed since English became the language of Wiltshire and Somerset, and since it predominated in Devonshire and Cornwall. Yet though these counties have entirely changed their language we have no reason to suppose them to be less British in blood than

they were in the time of King Alfred, 1000 years ago. And in Alfred's time we learn from Asser that even the Isle of Thanet was also known by its British name Ruim, and Nottingham as Tiggocobauc, just as at the present day a well-known Cumberland mountain is sometimes called Blencathra, and sometimes Saddleback. It is also worth notice that when Alfred was hard pressed by the Danes, and became a fugitive, it was to a refuge in Somerset (or West Wales) that he retreated, and from West Wales he collected most of the army that enabled him to defeat the Danes at Edington, and make the peace of Wedmore. And we have no reason to suppose that the extension of the frontiers of Mercia and Northumbria at the expense of Wales and Strathclyde was, on the whole, attended by greater slaughter and devastation than were the wars between the Angle and Saxon kings themselves. For with states as with languages, a slight superiority tends to increase by the mere influence of growing prestige; and a small state to welcome the over-lordship of a larger and more quickly increasing one, as a means of insuring protection and peace.

The very valuable work of Mr. F. Seebohm on 'The English Village Community' gives most important evidence tending to show a much greater continuity between the Romano-British and the Anglo-Saxon community than has generally been supposed. He points out that the land-system of the Saxon *hams* and *tuns* was a manorial one, and that there is no foundation for the view that "the Saxons introduced everywhere free village communities on the system of the German *mark*, which afterwards sank into serfdom under manorial lords." He then considers the question whether the Saxons introduced the manorial system themselves or adopted it on finding it already established in Roman Britain. It appears that the *hams* of England are most numerous in the south eastern counties from Lincolnshire and Norfolk to Sussex, and that they are densest in Essex, in which county, however, the *h* is often dropped and becomes *am*. Passing to the continent, Mr. Seebohm shows that the heims—the equivalent of the hams—are most numerous in what was

once the Roman province of Germania Prima (the present Alsace) and around Mayence—districts into which German populations had come early and remained long under Roman Rule. These districts abounding in *heims* shade off into others in which names ending in *villa* or *wilare*, *weiler* or *wyl*, are common. This fact, he remarks, suggests very strongly that here, as in England, *ham* and *villa* were synonyms for the same thing, the former being the German, the latter the Latin name. In some instances the name of the same place has, in the charters of these districts, the suffix *villa* or *wilare*, and sometimes *heim*. The Roman villa is known to have been exceedingly like a manor, and a clear and continuous connection can often be traced in Gaul between the Roman villa and the manor. Mr. Seebohm also notices the evidence of local names ending in *ing* or *ingas*. Local names with this suffix are found on the continent as well as in England, and many writers have called attention to them as the original Saxon clan settlements on the basis of the free village community. But Mr. Seebohm points out that the actual evidence as to what a Welsh tribal household was, is more likely to guide truly than any theoretical view of the village community under the German mark system. The tribal household in Wales was "the joint holding of the heirs of a common ancestor from the great-grandfather downwards, with redistributions within it to make equality, first between brothers, then between cousins, and finally between second cousins; the youngest son always retaining the original homestead in these divisions." Now it is well-known that in the south-east of England, and especially in Kent (he remarks), the custom of Gavelkind has continued to the present day, retaining the division among male heirs, and historical traces of the right of the youngest son to the original homestead. As regards England generally, the map shows that the largest number of places mentioned in Domesday Survey ending in *ing* occurs east of a line drawn from the Wash to the Isle of Wight, the county where they are most plentiful being Sussex. It is a singular thing, he adds, that the personal names prefixed in the *ings* in England, Flanders, the Moselle valley

around Troyes and Langres, in the old *Agri Decumates* (now Wirtemburg), and even those in Frisia are to a very large extent identical. Thus, if the names were clan-names it might be impossible to deny that the English and continental districts were peopled by branches of the same clans. But the names being personal and not family or clan names "the Baldo of one tribe need not be closely related to the Baldo of another tribe, any more than John Smith need be related to John Jones." Still this singular identity even of personal names suggests that those who gave them to English villages were much more probably colonists from Romanized Germany than Angles, Saxons, or Jutes. These holdings of tribal households may have been from the first (Mr. Seebohm thinks) embryo manors with serfs on them. "As a matter of fact the actual settlements in question had, at all events, become manors before the dates of the earliest documents." Tribal households may have occasionally expanded into free village communities. But the evidence is against the view that German emigration generally took that form.

In summing up the economic evidence, Mr. Seebohm remarks that it is sufficient to prove either that there was a sufficient degree of continuity between Roman Villa and Saxon Manor to preserve the type, or that the German invaders must have been thoroughly Romanized before their arrival here; it being utterly impossible that a system abounding with survivals of usages of the Roman-German province could have been introduced into England by un-Romanized pirates from Northern Germany.

In addition to this evidence of continuity in land tenure, Mr. Seebohm points out how common is that of continuity between Roman and English villages in the small district of which Hitchin is the centre, and which he has had an opportunity of examining. He also notices the amount of archæological evidence of a similar kind elsewhere which accumulates as time goes on. Turning from villages to towns, I may remark that Professor Pearson[24] gives a list of about fifty towns in illustration of the very considerable amount of con-

[24] 'Historical Maps of England.'

tinuity between Roman and Saxon times. Among them I need hardly say are Colchester and Maldon. But for further evidence of the survival of Roman manners, customs, &c., for centuries after their departure from Britain, I have no space, and can only refer those interested in the subject to Mr. Coote s work on the Romans in Britain.

In short, the evidence seems to me to favour the view of Professor Pearson that the more Romanized Britons, and the many Roman colonists of various nationalities in the eastern half of Britain, easily consented, as a rule, to exchange the rule of Roman officials for that of Anglian or Saxon chiefs, while the less Romanized and civilized tribes of the West preserved more feeling of British nationality, and showed more animosity against the Teutonic invaders. For the maps show but few Roman towns or roads west of a line ranging from Dorset through Gloucestershire and West Yorkshire to the mouth of the Tweed. At the same time, as Professor Pearson points out, the early Welsh literature shows but the slightest acquaintance with the country east of the line just mentioned. No doubt eastern, or the more Romanized half of Britain was to a great extent a land alien in feeling, and to some extent in language, to the wilder tribes of the West. For we have the evidence of Tacitus that one of the principal objects of the introduction of Roman luxury among the British chiefs was to check the formation of feelings of nationality and manly independence, and to render those accustomed to the Roman toga and banquet the willing slaves of Roman rule ('Agricola,' Chap. 21).

While the fact that our language is mainly Anglo-Saxon has caused our present population to be considered as much more Anglo-Saxon than the evidence seems to warrant, it is probable that the Scandinavians, who only began to settle on our shores more than four centuries after the coming of the Angles, Saxons, and Jutes,—when the language of the latter had established its supremacy,—must have had their numbers and influence considerably under-estimated. Of course there are plenty of Scandinavian place-names, especially in the northern counties, such as Grimsby, Derby, Netherby, and

Allonby; Althorpe, Rampsholme, Crosthwaite, and others. And in the North of England and the Scottish Lowlands many Danish expressions form part of the language of the peasantry. When Burns, for instance, says, "*it gars me greet*," or when Edie Ochiltree remarks, with reference to the supposed Roman Camp, that he "*minds the bigging o't*," the influence of the Danes becomes strikingly manifest. With regard to institutions, Worsaae in his well-known book on the Danes in England,[25] states that "it must now be regarded as a point quite decided that the earliest positive traces of a jury in England appear in the Danelag, among the Danes established there." He notices a curious point which illustrates the uncertainty of the evidence of language and place-names as marks of the relative intensity of the settlements of a race in different localities. In the Scottish Lowlands the popular talk is much fuller of Scandinavian terms than that of the middle and northern districts of England. Yet the Scandinavian place-names of the Lowlands are very few in number, and, putting other evidence aside, would suggest but a very slight Scandinavian admixture. The probable explanation of apparent anomalies of this kind is that in the counties abounding in Scandinavian place-names the settlement was made comparatively early and bore more or less of the character of a conquest. In such circumstances the social and political importance of the invaders might probably result in their establishment of a larger number of place-names than their mere numbers would lead us to expect. On the other hand, a gradual and peaceful immigration into a settled country—as that from England into Scotland after the Norman Conquest—might have but little effect on the already settled place-names, though so important from its numbers as to seriously modify the talk of the peasantry.

Worsaae saw but few persons of Scandinavian appearance in the south of England, and in the "confusion of people in London." In the midland, and especially in the northern

[25] 'An account of the Danes and Norwegians in England, Scotland, and Ireland,' by J. J. A. Worsaae, Lond. 1852.

counties, people of the Scandinavian type seemed to him to be common. "The form of the face is broader than in the South, the cheek bones project a little, the nose is somewhat flatter, and at times turned a little upwards, the eyes and hair are of a lighter colour, and even deep-red hair is far from being uncommon. The people are not very tall in stature, but usually more compact and strongly built than their countrymen towards the south." He adds that in midland and northern England, particularly in the rural districts of the north, he saw every moment persons whom, had he met them in Denmark or Norway, he would never have supposed to be foreigners.

Surnames ending in *son*, such as Wilson, Anderson, Johnson, the Danish form of which is *sen*, are especially common in the north of England. Worsaae states that this ending is quite peculiar to the countries of Scandinavia, whence it was brought into England, and that the name Johnson, so common in England, is also, perhaps, the commonest surname in Iceland. But though the evidence derived from physical characteristics and surnames is enough to show the largeness of the Scandinavian ingredient in our population north of the ancient Watling Street, it is likely that the present holders of surnames of Scandinavian type are by no means so exclusively Scandinavian as their names, apart from any mixture of races since their arrival here. For certain names, such as John and Thomas, did not come into use in England till after the Norman Conquest, and surnames were unknown here before that period. Dr. Beddoe,[26] who has fully discussed the evidence bearing upon early surnames, states that in a list of tenants of the Bishopric of Durham, dating from 1183, patronymics "now so exceedingly common in the north of England, seem to have been comparatively rare," though the favourite form of surname in that district in the time of Edward I.

The ethnological evidence of surnames may vary indefinitely in value. In many cases surnames have been spelled in a variety of ways by one generation after another till they

[26] 'Races of Britain,' Lond. 1885.

have arrived at some form but slightly susceptible of modification. For example, I have seen the well-known Graham spelt in documents of various ages as Grame, Graeme, Greyme, and Grahme. Anglo-Saxon and Scandinavian surnames have, on the whole, been little altered in course of time, but Celtic names on the one hand, and those introduced by the Normans and Huguenots on the other, must often have been so Anglicised as to leave no traces of their origin at the present day. No doubt shortly after the Norman Conquest the tendency among landowners may have been towards the Normanization of surnames, but the surnames of the swarm of Norman artisans, and others of the lower social grades, must, in the majority of cases, have speedily become more English in form. But we know more of what actually occurred in the case of the Huguenots. Mr. Smiles tells us of many instances in which Huguenot churches established in various localities were closed in the next generation from want of members, one of these being at Thorpe-le-Soken in Essex. Old members died, and the young did not fill their places, being desirous to identify themselves with the nation in whose land they had settled. From a sermon by Mr. Bourdillon, minister of the Artillery Church in Spitalfields, preached in 1782, we learn that at the time of his appointment, fifty years before, there were twenty flourishing French churches in London. In 1782 nine of them had been closed, and the remaining eleven were hastening to their end. Of the original French surnames of the members of these once numerous congregations but few now exist, the great majority having been Anglicised in a variety of ways. Thus while D'Aeth has become Death; Bouchier, Butcher; and Bourgeois, Burgess; L'Oiseau has been translated into Bird, Le Jeune into Young, Le Noir into Black, Le Roy into King, and Le Fevre into Smith. Again, Dieudonné has been altered into Dudney, Brasseur into Brassey, and De Moulins into Mullins. Many other examples might be given, but the above are enough to illustrate the processes of conversion.

After a careful consideration of the evidence bearing upon the question, Dr. Beddoe is inclined to consider that the

proportion of Norman or French blood in southern and eastern England in the time of Edward I. may have equalled 15 or even approached 20 per cent. It was greater than this, he thinks, in the south-midland counties, and was considerable in the north and east of Yorkshire.

The Huguenot immigration—in which I include that of the Flemings and Walloons who came over on account of religious persecution, as well as the French—having extended over a period of 140 years, from the time of Edward VI. to that of James II., has probably not had its numerical importance fully recognised.[27] In the time of Queen Elizabeth it was found that 4679 foreigners were settled in Norwich, while Colchester in 1609 contained 1300 Walloons and other foreigners. In Elizabeth's time, also, Flemings and Walloons established the fishery at Yarmouth, and the arts of salt-making and herring-curing. After the revocation of the Edict of Nantes in 1685 it is computed, says Mr. Smiles, that 100,000 French manufacturers and workmen fled into England, chiefly from Normandy and Brittany. At the beginning of the last century there were 35 French churches in London and the suburbs. Silk-throwing was introduced into Essex in the last century, at Braintree, by one of the Courtaulds; and in the parliamentary records of this county the names of Ducane, Pechell, Papillon, and Rebow are prominent.[28]

The British Association appointed, in the year 1875, an Anthropometric Committee to collect evidence with regard to the physical characteristics of the inhabitants of the British Isles. The final report of this committee appears in that of the British Association for 1883, and is illustrated by five maps of the British Isles, shaded so as to show the comparative stature, weight, fairness, and darkness of the inhabitants of the various counties and districts. From the map showing stature we learn that the tallest men live in Galloway and

[27] It must not be forgotten that a considerable number of Frenchmen came over here before the promulgation of the Edict of Nantes in 1598, though a much greater number arrived after its revocation in 1685.

[28] See Smiles on the 'Huguenots in England and Ireland.'

Ayrshire, while the men of Berwickshire and the Lothians are but little inferior to them ; the first being a decidedly Celtic, the latter a probably Anglian district. Looking generally we learn that of the nine categories of adult males from No. 1, with an average of more than 5 ft. 10 in. to No. 9, averaging 5 ft. 6 in. to 5 ft. 6½ in., the three shortest divisions are confined to certain districts of England and Wales. In Ireland it is noticeable that the people of Munster and Connaught average half an inch more than those of Ulster and Leinster. In England we find that the average stature is lowest in Somersetshire, Gloucester, Wiltshire, South Wales, the counties bordering on Wales, Surrey, Middlesex, and Hertfordshire. This is what might have been expected when we remember the influence of the pre-Celtic Silurians in South Wales and the districts on its borders, and the numbers of foreign artisans who have long been settled about London. The tallest Englishmen appear to be found in the North and East Ridings of Yorkshire, while the West Riding people are among the shortest.

Turning to the second map, which shows the average weight, we find the adult males divided into seven categories, the heaviest men (No. 1) being those averaging from 175 to 180 pounds, the lightest (No. 7) those from 145 to 150 pounds. We find that Nos. 1, 2, and 3 are confined to Scotland, and that the heaviest men—on the average—are those of Celtic Argyllshire and Anglian Berwickshire, and the Lothians ; the next heaviest being the men of Strathclyde and Perthshire. and then those of the northern Highlands and Aberdeen. In England and Wales the heaviest men appear to be those of Northumberland, north and east Yorkshire, Lincolnshire, Norfolk, and Suffolk, on the east, and those of Cornwall, North Wales, and Staffordshire on the west, who all belong to group No. 4. The heaviest Irishmen, those of Ulster, belong to No. 5, and weigh from 155 to 160 pounds. To this group belong the men of South Wales, Cumberland, many of the midland counties, the people of the south coast from Devonshire to Kent, and those of Wiltshire, Berkshire, and Essex. Next in weight come the men of Connaught and

Munster, and those of Durham, Lancashire, and Cheshire, together with the inhabitants of the West Riding of Yorkshire, Nottinghamshire, some counties on the borders of S. Wales and on the north bank of the Thames, and part of Lanarkshire. The lightest people appear to be those of Leinster, Somerset, Gloucestershire, Warwickshire, Shropshire, and Surrey.

In the third map the distribution of adult males with light hair and eyes is shown. They are placed in five divisions. In districts coloured as No. 1, a proportion of more than 50 per cent. of fair people has been found, while—passing over intermediate subdivisions—in No. 5 the average number of fair people is only from 30 to 35 per cent. The results are very singular. In Ireland, Leinster and Connaught are placed in No. 1; Ulster in No. 2; and Munster in No. 3. In Scotland the counties included in No. 1 are a part of Lanark and Dumbarton, Kincardine and Forfar, Berwickshire and the Lothians. In England the three counties with the highest average of fair people (No. 1) are Northumberland, Durham, and Gloucestershire. In No. 2 are Yorkshire, Lancashire, Cheshire, Derbyshire, Nottingham, Stafford, and Surrey. No. 3 includes Cumberland and Westmoreland, Wales, and the southern counties, Oxford, Buckingham, Northampton, Cambridge, Huntingdon, and Norfolk. No districts in Ireland or Scotland are included in No. 4, but in England we have Lincolnshire, Warwick, Worcester, and Berkshire; while the counties with the fewest fair people (No. 5) appear to be Leicester, Suffolk, Essex, Hertford, and Middlesex.

Next comes a map showing the distribution of adult males with dark eyes and hair. The first division, No. 1, includes the districts having less than 20 per cent. of dark-eyed and dark-haired people, while the last, No. 5, indicates those with more than 35 per cent. We learn that the districts with the fewest dark people (No. 1) are Connaught in Ireland; Kincardine, Forfar, the Lothians, Berwick, Roxburgh, Selkirk, Peebles, and Dumfries, in Scotland; and Derbyshire in England. In Ireland Leinster contains the largest number of dark people (No. 4), and in Scotland the

dark people most abound in Aberdeenshire, Elgin, and Banff (No. 4). In the fifth grade, which includes the districts having the largest percentage of dark people, no counties of Scotland or Ireland appear, and in England and Wales they are distributed in an apparently strange manner. Instead of being concentrated in and around South Wales, the darkest districts are Anglesea and the counties of Carnarvon, Merioneth, Montgomery, Shropshire, Worcester, Warwick, Leicester, and Lincoln. South of this belt of country between Anglesea and Lincolnshire we find equally dark districts in the counties of Cambridge, Huntingdon, Bedford, and Essex; and south of the Thames in Kent, Sussex, Hampshire, and Berkshire.

Of the fifth map, which shows the distribution of adult males with light eyes and dark hair, I will only remark that the counties having the largest numbers of such persons, or in other words more than 30 per cent., are Middlesex, Hertford, Dumfries, and Roxburgh.

It is possible that future observations may slightly modify the results here given, but in any case these maps sufficiently suggest that British Ethnology is not quite so simple a thing as it is popularly supposed to be. If we take stature, or colour of hair and eyes, we find a much greater diversity in what was once Roman Britain than in Scotland beyond the Forth, and in Ireland. And if we take weight, we find in Scotland and Ireland nothing of the curious mingling of light and heavy districts that is obvious in England. In Scotland we see the darkest people concentrated in the district between Inverness and Aberdeen, which was known in the time of Macbeth as Moray and Buchan, and was the head-quarters of his power, a fact which strikingly confirms the opinion of Professor Rhys, based on other considerations, that Macbeth was the champion of the Picts, and that the Picts were mainly the dark-haired pre-Celtic Iberians.[29] In Ireland the distribution of the dark people is remarkable in another way. We should naturally expect to find the dark-haired Iberians most numerous west

[29] This same district is also that, in Scotland, which contains the fewest fair men,

of the Shannon, and the stature there to be somewhat less than that attained in other parts of Ireland. But Connaught and Munster are the two tallest districts of Ireland, and Connaught has the fewest dark people. It seems likely that the Iberian element was more generally diffused in Ireland than in England and Scotland, and became, in consequence, more complete and evenly absorbed by the Gael. Leinster can hardly owe its specially large proportion of dark people to an unusual abundance of Iberians, but rather to the Anglo-Norman barons and their retainers who landed with, and after, "Strongbow," and to other immigrants from England and Wales. Turning to England, we find the distribution of the dark people much more complicated. Of course the difficulty is to account for the presence of so large a number of dark-haired people in the district east of a line drawn from north-west Lincolnshire to the western border of Hampshire, and to explain the contrast between the abundance of dark-haired people in Lincolnshire and their fewness in East Yorkshire—two districts generally considered equally and exclusively Anglian and Scandinavian. The supposition of a specially large survival of the Iberian element in these eastern counties south of the Humber is a singularly unlikely one. And the influence of the immigration of Norman, French, or Walloon artisans—supposing them to have been more dark than fair—would be chiefly shown in and near London, in Norwich, and in other towns, and would not account for the fact that neither London nor Norfolk is so dark as Lincolnshire. On the other hand, there seems to be little doubt that the Angles, Saxons, Jutes and Scandinavians, who are known to have settled thickly in these counties, and whose descendants are unanimously supposed to be more numerous in them than in the counties to the west, were fair people. The most probable explanation of this curious prevalence of dark people in the more Teutonic counties of England [30]

[30] It must be remembered that the counties having the smallest percentage of fair persons are also in the eastern half of England. They are Leicester, Suffolk, Essex, Middlesex, and Hertford. Next to them are Lincolnshire, Bedfordshire, Berkshire, Warwick, and Worcester.

appears to me to be supplied in Mr. Seebohm's work on 'The English Village Community.' It will be remembered that, as I have already stated, Mr. Seebohm brings forward evidence tending to show that the Teutonic people who gave their personal names so largely to the villages in these very counties were much more probably Romanized Germans who had been introduced here as forced colonists during the Roman Occupation of Britain, than Angles, Saxons, or other un-Romanized North Germans. Now while the Saxons and Angles were fair, the southern Germans, who were introduced into this country by the Romans, were probably—as the south Germans now are—a much darker race. This independent confirmation of the truth of Mr. Seebohm's views seems to me a peculiarly interesting and valuable result of the labours of the Anthropometric Committee.[31] And the two results, taken in conjunction, enable us to explain why these eastern counties, in spite of the number of dark people they contain, still remain thoroughly Teutonic in type. In other words, they enable us to understand why the inhabitants of the eastern counties, whether dark or fair, are slow and not easily excited, while the fair Celts and dark Iberians of the west constitute a people of a much more lively temperament.

It may be well to illustrate this difference of temperament between the Teutonic and Celtic counties by a few examples. As regards Essex, when Professor Meldola, Mr. Cole, and I

[31] In the 'Times' of September 21, 1886, the following remarks appear. "*Curious Researches of an Anthropologist.*—Professor Rudolf Virchow, the celebrated surgeon and anthropologist, has lately prepared some interesting tables concerning the colour of the hair, eyes, and skin among the German school chiidren. He examined 6,758,827 pupils, being nearly four-fifths of all the youth of 'A. B. C.' age. Of these 2,149,027 or 31·08 per cent. belonged to the blonde type, 942,822 or 14·05 per cent. to the brunette, and 3,659,978, or 54·15 per cent. to the blonde-brunette or mixed type. The territorial division of the principal types corresponds accurately to the geographical boundaries of north, south, and middle Germany, 43-3·36 per cent. of the pure blondes being found in the northern districts, 32-5·28 per cent. in the middle, and 24-5·18 per cent. in the southern ones. The river Main thus becomes an anthropological line of significance. In general, the further south one goes the more brunettes he meets, South Bavaria mustering but 14 per cent. blondes."

enquired of an esteemed member of this Club, having a large medical practice at Colchester, as to the amount of injury to nervous system, &c., caused by the earthquake, we were informed that it had been practically nothing, owing to the unexcitable character of the inhabitants of the damaged district. Among the English-speaking but mainly Celtic districts of the west, the maps show us that the proportion of dark people is the same in Cornwall as in Suffolk, in Ayrshire and Galloway as in Norfolk. Now Ayrshire and Galloway were the head-quarters of those stern religious enthusiasts, the Covenanters, while in Cornwall were achieved some of the greatest successes of Wesleyanism. If we turn from these far-apart but equally Celtic districts to the especially Teutonic counties of East Anglia, we find that in no part of England did Wesley meet with more discouragement than in the diocese of Norwich, which includes Norfolk and Suffolk. Dr. Jessopp, in his 'Diocesan History of Norwich,' remarks that Wesley appears to have been shocked and horrified by the reception accorded him in East Anglia, his journal being full of lamentations at the perverseness and fickleness of the people. For not only did Wesley find it difficult to arouse religious emotion in the breasts of the East Anglians, but their enthusiasm also tended to cool with unprecedented rapidity. In three years his Society had almost dwindled away, and he writes:—"I have seen no people in all England so changeable as this." And Dr. Jessopp, whose thorough acquaintance with this district is unquestionable, remarks that "the cold and lethargic temperament of the East Anglian people is not easily stirred to enthusiasm; soon roused to hatred, they are very slow to love, and the emotional in them seems to be reached only through their resentment." This evidence as to temperament thus amply confirms the conclusions derived from the labours of Mr. Seebohm and those of the Anthropometric Committee, that to the mingling of the dark and fair Teutons, and not of fair Teutons with Celtiberians, the dark element of our eastern counties is mainly due.

It should not be forgotten that the Angles, Saxons, and Jutes, on the one hand, and the Scandinavians on the other, who are commonly classed together as Teutonic, differed from each other in many important respects. Mr. Matthew Arnold, whose book on the 'Study of Celtic Literature' was written shortly after the Schleswig-Holstein war, seems to have been amused at the long catalogues of the many points of unlikeness between the genius and disposition of German and Dane, brought forward by Germans about that time. This induces him to remark that "there is a fire, a sense of style, a distinction in Icelandic poetry which German poetry has not." He adds that the fatal humdrum and want of style of the Germans have marred the *Nibelungen*, while everywhere in the poetry of the Scandinavian Edda "there is a force of style and a distinction as unlike as possible to the want of both in the German *Nibelungen*." This sense for style, he says, the Celts have in a wonderful measure, and he is inclined to think the possession of it by the Scandinavians may perhaps be due to an early Celtic influence or intermixture. Speaking of English poetry Mr. Arnold remarks: "If I were asked where English poetry got these three things —its turn for style, its turn for melancholy, and its turn for natural magic, for catching and rendering the charm of nature in a wonderfully near and vivid way, I should answer, with some doubt, that it got much of its turn for style from a Celtic source; with less doubt, that it got much of its melancholy from a Celtic source; with no doubt at all, that from a Celtic source it got all its natural magic." And again, "The Celt's quick feeling for what is noble and distinguished gave his poetry style, his indomitable personality gave it pride and passion, his sensibility and nervous exaltation gave it a better gift still, the gift of rendering with wonderful felicity the magical charm of nature." And with regard to the Celtic love of nature, Professor Veitch remarks in his 'History and Poetry of the Scottish Border':—"The Cymri, who were first in the district, must have had a singularly fine musical sense; and although we are not able always to trace the inner significance of their names of hill and stream and glen,

they appear to have had a purer, deeper feeling for the nature around them, more communion with it, more sympathy with it, alike in its softer and in its sterner aspects, than their successors had, or than for long appeared in Saxon or English literature." He adds that this feeling for nature "was shared in, if not by the Saxon, at least by the romantic and impassioned Scandinavian."

This examination of the Evidence bearing upon British Ethnology has made it evident that neither stature nor complexion in themselves tell us whether a man is probably either pre-Celtic, Celtic, or Teutonic; also that the Scandinavian and the Anglo-Saxon branches of the Teutonic family have by no means contributed similar qualities to the making of England.[32] The relative proportions of the Celtic and Teutonic elements cannot, of course, be ascertained with any approximation to accuracy. Dr. Beddoe speaks of Mr. Grant Allen's excellent little book on Anglo-Saxon Britain as giving the fairest account that he has seen; and Mr. Grant Allen thinks it highly probable that not half the population of the British Isles is really of Teutonic descent. Mr. Grant Allen, however, appears to have written before the publication of Mr. Seebohm's book, and consequently does not recognise so much continuity between Roman and Saxon Britain as he otherwise would probably have done. And this, of course, implies that his estimate of the pre-Celtic and Celtic elements is lower than it would otherwise have been. On the whole, if we estimate the pre-Celtic, Celtic, and Scandinavian elements combined as amounting to two-thirds, and the united Angle, Saxon, and Jute element as one-third, the influence of the latter is more likely to have been over-estimated than the reverse.

But this address is growing unduly long. I will therefore only add, in conclusion, that if to Celtic or Celtiberian sources we owe much of the beauty of our literature, and to Celt and Scandinavian much of our energy, and of the fiery valour o

[32] For a comparison of the literature of the Anglo-Saxon and Scandinavian see Mr. Metcalfe's book 'The Englishman and the Scandinavian, London, 1880.

the British soldier and sailor, we may be indebted largely to the Anglo-Saxon for the love of compromise and hatred of extremes that have hitherto allowed of the working of parliamentary institutions without violent and fatal shocks. Nor must we forget what is due to the Huguenots who taught us so many useful arts, or to the Normans who welded Wessex, Mercia, and Northumbria into the English Nation.

Appendix.

Notes on the Survival of Fragments of Celtic Languages in English-speaking Britain.

Mr. A. J. Ellis, in a paper on the 'Anglo-Cymric Score' (Trans. Phil. Soc. 1877–8–9), discussed a set of numerals, from one to twenty, of Cymric origin, formerly much used by the shepherds of north-western England, and still to some extent known there. Mr. Ellis examined fifty-three different versions of this score; but doubts whether they are a survival of the former Cymric speech of that region or an importation thither from Wales. In a review of Mr. Ellis's paper in the 'Academy' (May 17, 1879), Mr. Henry Bradley gave four hitherto unpublished versions of the score; 1, Leeds or York; 2, Bawtry, Notts; 3, Sheffield; 4, Brighouse, Yorkshire. From a comparison of all the versions hitherto published Mr. Bradley is confident that they all descend from one primitive type, and considers that "these Anglo-Cymric numerals are entitled to be regarded as a genuine remnant of the British dialect of the north-west of England, and as proving that that dialect was nearly identical with the oldest known Welsh."

In the 'Academy' of Nov. 20th, 1886, appears the following note on the still more remarkable survival of a tongue of Gaelic affinities:—

"A Pre-Historic Language yet surviving in Britain.

"At the recent Orientalist Congress in Vienna, Mr. C. G. Leland read a paper on 'The Original Gypsies and their Language,' not the least interesting part of which was a

digression treating of an ancient tongue yet surviving as a spoken language in Great Britain. The facts, as stated by Mr. Leland, are so curious that they deserve to be quoted *in extenso* :—

'Three or four years ago there was probably not an educated man in all Great Britain who was aware of the existence in that country of the very singular Celtic language known as 'Shelta,' which is peculiar to tinkers, but which is extensively understood and spoken by most of the confirmed tramps and vagabonds. It is not mentioned in the Slang Dictionary; the English Dialect Society has ignored it; and thus far I believe that I am the only man who has collected or published a word or a vocabulary of it. . . . I doubt if I ever took a walk in London, especially in the slums, without meeting men and women who spoke 'Shelta'; and I know at this instant of two—I really cannot say promising—little boys who sell groundsel at the Marlborough Road Station who chatter in it fluently. . . . .

'As 'Shelta' is somewhat mixed with Gypsy, and as the two languages are often spoken by the same persons, especially the half-blood Romanys, I will here give a brief account of my discovery of it. Once at Bath, England, I met a tramp who told me that Romany was being supplanted by a kind of language like Old Irish, which was difficult to learn. A year after, in company with Prof. Palmer, I met with another vagabond, who told us the language was called 'Shelta.' He knew about a hundred words of it, which we wrote off at his dictation. This vagabond was a well-educated man. Two years after, in America, I found an Irish half-blood gypsy tinker who spoke 'Shelta' quite perfectly, and also Irish, Gaelic, and Welsh. He was absolutely certain that 'Shelta,' while it was pure Celtic, was quite separate from the other tongues. Its pronunciation is strongly Gaelic; its words are, however, generally unlike it, though it has roots in common. My informant, who very much enlarged my vocabulary, himself pointed out differences between the terms in 'Shelta' and Old Irish. According to his account, the tinkers had from very ancient times always been a closely allied clan, intermarrying and speaking this peculiar language. Their unity began to break up 'about the time that railroads came in.' Since then 'Shelta' has declined. There are very few now living who can speak it perfectly.

'It has been very ingeniously suggested that as the tinkers of Great Britain may be the descendants of the old bronze workers, so their tongue may have come down to us from

prehistoric times. Discoveries have shown that the early bronze-smiths were nomadic, that they went about from village to village, making and selling new objects and buying up old and broken ware to melt and remould. The bronze-worker's craft was closely connected with that of the jeweller, in most cases both were exercised by the same person. His wares were immensely valuable in those days, out of all proportion to the present worth of such objects. Therefore the bronze-smiths must have travelled in large bands for mutual protection. Nothing is more likely than that they formed, in time, a community with distinct laws and language. Nor is it improbable that this was transmitted to the tinkers. It takes a long time for men to form a distinct class with a separate tongue. The Celtic tinkers of England are unanimous in claiming for their class or clan a very great antiquity. Now when we find in the same country two nomadic classes of men, pursuing the same calling of working in metal, though separated by a long historical interregnum, we may rationally surmise that they had a common origin and a common language.

'I have introduced these observations on 'Shelta' in the hope that they will induce some sound Celtic scholar to take up the subject and investigate it thoroughly. Many curious discoveries await the man who will do this. There are still living in Scotland many old families of 'Tinklers,' as they are called, who retain many traditions of their ancestors. If these were thoroughly examined much might be learned.''

The interesting note from the 'Academy' of November 27th, 1866, printed below, tends to show that the early metal workers in Palestine, among races quite distinct from those of the British Isles, were also nomadic. Doubtless, in the early metal period, this was a general habit of blacksmiths and tinkers in countries inhabited by a sparse pastoral and agricultural population:—

"Travelling Tinkers in Ancient Palestine.

"Mr. Leland's interesting paper, quoted in the last number of the 'Academy,' reminds me that we may find indications in the Old Testament of the existence of a tribe of travelling tinkers or blacksmiths in ancient Palestine. The Kenites, or Kainites, led a nomad life extending from the Amalekites in the South (1 Sam. xv. 6) to Kadesh-naphtali in the North

(Judg. iv. 11), though their chief seats seem to have been at Sela or Petra (Numb. xxiv. 21), and the South of Judah (1 Chron. ii. 55, 1 Sam. xxvii. 10). The name is identical with the Aramaic *kainay*, 'a smith,' which makes it clear what the occupation of the tribe must have been. Whether 'the smith' took his name from the tribe, as 'the merchant' from the Canaanite of Phoenicia, or whether the tribe derived its name from its occupation is immaterial; the word *kayin*, 'a spear,' however, renders the second alternative the more probable. In any case, the Kenites will have been a clan of wandering blacksmiths, like the clan of smiths who once wandered over Europe. This explains the curious fact that at the beginning of Saul's reign 'there was no smith found throughout the land of Israel,' and the Israelites had to go to the Philistines in order to sharpen their agricultural implements (1 Sam. xiii., 19-22). The Philistine invasion, in fact, had driven the Kenites, or 'smiths,' out of a country where in the time of Ramses II., according to the 'Travels of a Mohar,' a blacksmith could be met with whenever the chariot of an Egyptian tourist needed repair. Perhaps it is not without significance that the wife of Heber the Kenite finds a hammer ready to her hand in her tent (Judg. iv. 21). At all events it is noticeable that Tubal-Kain was the 'instructor of every artificer in brass and iron'; and that his father, Lamech, like Kain, the son of Adam, had slain a man.

A. H. Sayce."

Queen's College, Oxford: Nov. 22, 1886.

[Editorial Note.—The first series of the 'Transactions of the Essex Field Club' terminates with the present sheet. On and after January, 1887, the 'Transactions' and 'Proceedings' of the Club will be combined, and issued as a monthly periodical, entitled, 'The Essex Naturalist, being Journal of the Essex Field Club.']

THE ESSEX FIELD CLUB.

FOUNDED JANUARY 10TH, 1880.

Patron.

H.R.H. THE DUKE OF CONNAUGHT AND STRATHEARN, K.G.

(*Ranger of Epping Forest.*)

President.

T. VINCENT HOLMES, F.G.S., M.A.I., etc.

Application for Membership should be addressed to the Hon. Secretary, WILLIAM COLE, 7, Knighton Villas, Buckhurst Hill, Essex.

THE ESSEX NATURALIST,

BEING

THE JOURNAL ["*TRANSACTIONS*" AND "*PROCEEDINGS*"] OF THE ESSEX FIELD CLUB.

Published not LATER *than the 20th of each month.*

THE Council has resolved in future to issue the 'Transactions' and 'Proceedings' of the Club combined in the form of a monthly periodical under the above title. The journal will consist of 16 pages per month, but in all probability frequent "double numbers" will be issued, in order to keep pace with the rapid accumulation of papers which have been read before the Club. The 'Essex Naturalist' will be sent, post free, *to all members who are not in arrear with their subscriptions*, and will be on sale to non-members at a price not exceeding 6d. per sheet of 16 pages.

Contents.—The 'Essex Naturalist' will contain PAPERS read before the Club, or which may otherwise be placed in the Editor's hands, REPORTS OF MEETINGS of the Club, and, as space allows, a special feature will be SHORT NOTES, treating of the Natural History, Geology, and Pre-historic Archæology of Essex, so that the journal may serve as a medium for inter-communication between the members on subjects included in the programme of the Society. NOTICES of BOOKS, and other publications concerning Essex, will also appear from time to time, and it is hoped that the journal, when fully developed, will form an interesting register of the scientific activity of the county, whilst serving its primary purpose of keeping the members of the Essex Field Club promptly informed of all club news and proceedings.

Contributions.—The Editor will be very glad to receive communications from anyone interested in Essex, whether a member of the Club or not, relating to the above-named subjects; also books and papers for notice in the journal, and cuttings and extracts from periodicals and newspapers, furnishing information respecting the occurrence of new or uncommon plants or animals, the exposure of new geological sections by railway or other works, new well-sinkings, discoveries of archæological interest, &c. In short, any Essex material will b welcomed which may fairly be claimed as coming within the scope of the C

WEST, NEWMAN AND CO., PRINTERS, HATTON GARDEN, LONDON.

APPENDIX.—No. 1.

REPORT OF THE COUNCIL AND BALANCE SHEET FOR 1883;

ADDITIONS TO THE LIBRARY;

LIST OF MEMBERS, &c.

Corrected to January 26th, 1884.

ESSEX FIELD CLUB,

BUCKHURST HILL.

Dr. Treasurer's Statement of Account for the Year Ending 31st December, 1883. *Cr.*

	£ s. d.	£ s. d.		£ s. d.	£ s. d.
To Balance fron 1882		8 0 0	By Printing 'Transactions' (Part 7) and Cost of Engravings		105 19 5
,, Subscriptions, 1882	14 8 0		,, General Expenses :—		
,, ,, 1883	120 9 6		Printing Notices, Tickets, &c.	21 13 8	
,, ,, 1884	23 18 6		Stationery, &c., including Post-cards	4 8 5	
		158 16 0	Insurance, Septennial Policy	3 0 0	
,, Donations to Publication Expenses, and to General Fund		8 7 0	Rent for 1883	10 0 0	
,, Sale of Publications		5 5 5	Sundry Expenses	7 1 0	
Balance owing to Treasurer (less Cash in hands of Librarian and Collector, 16*s.* 4*d.*), £7 10*s.* 3*d.*		8 6 7			46 3 1
			,, Expenses of Museum, Library, and Binding		2 18 8
			,, Expenses at Field Meetings (above receipts)		4 9 4
			,, Postages		23 7 5
			,, Collector's Commission on Income, 1883		3 19 4
			,, Balance of Tea Fund, 1882, paid to Secretary		1 1 5
			,, Cash in hands of Librarian		0 5 5
			,, ,, Collector		0 10 11
	£188 15 0				£188 15 0

Life Composition Account.

	£ s. d.		£ s. d.
To Balance from 1882	25 0 6	By completion of Purchase of Cabinet	10 0 0
,, Two "Life Compositions" received in 1883	10 10 0	,, Balance to 31st December, 1883	25 10 6
December 31st, 1883.—To Balance....£25 10 6	£35 10 6		£35 10 6

Forest Camp Exploration Fund.

	£ s. d.		£ s. d.
To Balance from 1882	18 2 11	By Expenses of Surveying, Cataloguing, &c.	4 9 11
,, Grant from British Association for 1882	10 0 0	,, Sum set apart towards publishing Report	15 0 0
,, Subscriptions received in 1883	4 4 0	,, Balance, Cr., to 31st December, 1883	12 17 0
December 31st, 1883.—To Balance....£12 17 0	£32 6 11		£32 6 11

Denehole Exploration Fund.

	£ s. d.		£ s. d.
To Donations received in 1883	23 10 6	By Expenses of Advertising, &c.	1 15 7
December 31st, 1883.—To Balance....£21 14 11		,, Balance, Cr., to 31st December, 1883	21 14 11
	£23 10 6		£23 10 6

Liabilities.

	£ s. d.
To Balance owing to Treasurer (less 16*s.* 4*d.* in hands of officers) ..	8 6 7
Other Liabilities....*Nil.*	

Assets.

	£ s. d.	£ s. d.
By Balance in hand, Life Composition Account	£25 10 6	
,, ,, ,, Camp Exploration Account	12 17 0	
,, Sum set apart for publishing Report	15 0 0	
,, Balance in hand, Denehole Fund Account	21 14 11	
		75 2 5
,, Unpaid Subscriptions, £60.—Considered good (say)		30 0 0
,, Estimated value of Furniture (say)		50 0 0
,, ,, ,, Stock of 'Transactions' (say)		40 0 0

REPORT OF THE COUNCIL FOR THE YEAR 1883.

[Read at the Fourth Annual General Meeting, held at Buckhurst Hill, January 26th, 1884.]

In presenting the 4th Annual Report the Council has great pleasure in congratulating the members on the continued prosperity of the Club; the work on the whole having been successfully and pleasantly carried on during the past year.

Roll of Members.—The number of ordinary members elected into the Club in 1883 was 52, and two Honorary Members were chosen; 23 members have resigned or have been removed from the list, and we have to regret the loss of three members by death. Two members have compounded for their annual subscriptions. The census of the Club at the end of the years 1882 and 1883 respectively, was therefore as follows:—

	1882.		1883.
Patron	1	.....	1
Hon. members.....	10	.....	12
Life members	13	.....	15
Ordinary members	330	.....	354
	354		382

It is very desirable that the Club should possess a permanent and paying constituency of at least 400 members in order that the publications may keep pace with the activity of the Society. It is also important that the number of members living in the county should be increased, and the friends of the Club are desired to do all in their power to increase that class of members.

Some doubt seeming to exist as to the law of the Club with regard to Resignations, the Council thinks it right to point out that the rule reprinted below is a very necessary one, and must be enforced in the interests of the officers. The list of members must be fully made up before the 1st of January in each year to avoid confusion, and to enable the Council to form a trustworthy estimate of the income for the ensuing year. The Rule is as follows:—

"XI.—Members wishing to resign at the termination of any year are requested to inform the Secretary, in writing, of their intention to do so, on or before the first day of November of that year, and members not so resigning shall be considered liable for the subscription for the year next ensuing."

Finances.—The Treasurer's statement of receipts and expenditure for the year shows a deficiency of £8 6s. 7d., a result entirely due to the delay in the payment of a considerable number of subscriptions for 1882 and 1883 by about eighty members, the sum owing being estimated at £60. A portion of this money has been paid in since the books were closed on the 31st of December, and it is anticipated that the bulk of it will be collected. The Council has several times pointed out the very great inconvenience occasioned by such omissions, and the officers now strongly appeal to the good sense and good feeling of the members to remove this cause of friction in the otherwise smooth working of the machinery of the Club. In order to aid the Treasurer's work a *pink label* will in future be attached to the circulars sent to those members whose subscriptions are unpaid at the expiration of three months from the 1st of January, with a statement of the amounts due. This will kindly be received as an intimation that such subscriptions should be paid in immediately.*

Transactions.—Part 7 of the 'Transactions' was published in June, and contained (including two appendices) 298 pp. of closely printed matter, illustrated with forty-two woodcuts and two large folding plates. The Council highly appreciates the kindness of those gentlemen who, by the gift or loan of woodcuts and plates, enhanced so greatly the value and interest of our publication. Mr. Worthington Smith presented no fewer than twenty-six woodcuts; Mr. T. V. Holmes gave the two expensive plates; and Mr. Daw, Mr. Lister, Mr. Thomas, Messrs. Black, Cassell, Macmillan, and the Trustees of the British Museum aided also in enriching the 'Transactions.' Mr. R. M. Christy has contributed £3 towards the illustration of his memoir on the genus *Primula;* and Mr. W. D. Howard, Mr. Meldola, and Colonel Russell have kindly doubled their subscriptions (in accordance with a suggestion made in one of the presidential addresses) to increase the sum available for the expensive work of publication. Part 8 is now in hand, and in it will be printed all the unpublished papers and 'Proceedings' belonging to 1882. The Council proposes to make a vigorous attempt to overtake arrears of publication during the ensuing year, and trusts such efforts will be aided in every way by the members. Nothing would further more the objects the Club has in view, or give the Society a higher reputation among scientific workers, than the prompt publication of memoirs.

Library and Museum.—The Library continues to increase slowly by donations and exchanges, but it is a source of regret to the Council that no funds have as yet been available for *purchasing* books to any appreciable extent. It is hoped, however, before long, that the annual income will admit of stated grants being made to the Librarian for the important purpose of adding to the Library some of the valuable works which are constantly being issued from the press. It may not be out of

* [It is only justice to the Officers to state that the items in the Treasurer's account under the headings "General Printing," "Postages," and "Sundry Expenses" were largely swollen by the unavoidable expenditure incurred in connection with opposition to the Forest Railway Scheme. See *infra*.—Ed.]

place to refer in this connection to the fact that many of our members are scientific authors, and to suggest to them the propriety of placing copies of their works upon our shelves. It is generally known to the members that the late Mr. Darwin presented a copy of his last work to the Club, but it is not, perhaps, so well known that it was accompanied by a letter expressing a hope that his gift would be the means of leading other authors to follow his example. The names of those ladies and gentlemen who have during the year kindly presented volumes to the Library will be found in the supplementary catalogue issued with this report, and to them the Council begs to offer its best thanks. The books have now outgrown their present quarters, necessitating the purchase of additional book-cases. When these have been provided an effort will be made to classify the books somewhat, which, it is hoped, will be a convenience to those members who use the Library. The growth of the Museum has not been commensurate with the increasing strength and importance of the Club. Valuable contributions have, however, been received from Mr. G. C. Harcourt, Mr. G. P. Hope, and Mr. A. Bennett. A scheme for placing the Museum on a more satisfactory footing is now under consideration, and a preliminary meeting was held at Mr. E. N. Buxton's, in December last, for the discussion of ways and means. As soon as plans are matured the matter will be brought formally before the members.

Scientific Meetings, and Memoirs Contributed.—Eleven ordinary meetings of the Club have been held, at which the attendance has been good and the interest well sustained. The following is a list of the papers read at the ordinary and field meetings, excluding short notes and *viva voce* communications. In presenting this list the Council cannot but point with pride to the numerous memoirs submitted to the Society; the strong interest taken in our work by scientific men is one of the most encouraging features in the progress of the Club:—

"Darwin and Modern Evolution." R. Meldola, F.R.A.S., F.C.S.
"On the Sand-pit at High Ongar, Essex." Searles V. Wood, F.G.S.
"A Contribution towards the Knowledge of the Arachnida of Epping Forest." Rev. O. Pickard-Cambridge, M.A.
"On the Conservation of Epping Forest from the Naturalists' Standpoint." R. Meldola, F.R.A.S., F.C.S.
"On Evidences of Glacial Action on the Thames and in South Essex." F. C. J. Spurrell, F.G.S.
"Notes on a Post-Tertiary Deposit in the Cann Valley, with Additional Remarks on Similar Deposits in Essex." R. M. Christy and W. H. Dalton (H. M. Geol. Survey).
"On the Lichen-Flora of Epping Forest, and the Causes affecting its recent great Diminution." Rev. J. M. Crombie, F.L.S.
On English Plant-Names." J. Britten, F.L.S.
The Phenomena of Cyclical Propagation in the Animal Kingdom." Part 2. R. Meldola, F.C.S.
"Epping Forest; its Present Condition, with Suggestions for its Future Management; being Reports resulting from Recent Visits to the Forest." A. G. Burrows, F.L.S., and G. S. Boulger, F.L.S.

"On Rushes, and their Origin." David Houston, F.L.S.
"Recent Additions to the Fungus-Flora of Epping Forest, with a List of Algæ Collected within the Forest District." Dr. M. C. Cooke, M.A., F.L.S., &c.
"Report of the Committee appointed to Investigate the Earthwork known as the Loughton Camp, Epping Forest." Drawn up by the Hon. Secretary.
"On the 'Lower Orders' of Fungi." Worthington G. Smith, F.L.S., &c.
"On Fungi as Poisons." Dr. Wharton, M.A., F.Z.S., &c.
"Deneholes, and their Relation to other Earthworks." F. C. J. Spurrell, F.G.S.
"Miscellaneous Notes on Deneholes, 1883." T. V. Holmes, F.G.S., M.A.I.
"The Use of the Hygro-Spectroscope in Meteorology." F. W. Cory, M.R.C.S., F.R. Met. Soc.
"On the Occurrence of the Beech-Marten in Epping Forest." James English.
"On a Proposed Catalogue of the Pre-Historic Remains in Essex." R. Meldola, F.C.S., M.A.I.
"Fungi and their Spores." Arthur Lister, F.L.S.
"On a Specimen of a Whale, Rudolphi's Rorqual (*Balænoptera borealis*), lately taken in the River Crouch, Essex." Prof. Flower, F.R.S., &c.
"Some Additional Notes on Essex Water-Sheds." Prof. Boulger, F.L.S.
"Natural History Notes." R. M. Christy.

Field Meetings.—Six field meetings were held during the summer, all of which were very successfully carried out and well attended. On May 19th the members were invited by Sir Fowell Buxton to visit him at Warlies Park, and a most enjoyable afternoon was spent. On June 28th the Club was most hospitably entertained, in company with the Hertfordshire Natural History Society, at Easneye Park, Ware, by Mr. and Mrs. Thomas Fowell Buxton. On June 15th and 16th a two days' meeting was held at Grays for the purpose of exploring the Deneholes in Hangman's Wood, the Geologists' Association joining in the excursion, and bearing part of the expenses. On July 14th an informal meeting was held at Boxhill, in conjunction with the members of the Richmond Athenæum. The Fourth Annual Cryptogamic Meeting took place on September 29th, and was very numerously attended, despite the most unfavourable weather. An exhibition of specimens of Fungi, Mosses, Algæ, Flowering Plants, with microscopes, and botanical drawings and diagrams, was held in the evening at the Roebuck Inn, Buckhurst Hill. The success of this experimental exhibition emboldens the Council to continue and extend the same, and on Friday and Saturday, October 3rd and 4th, 1884, an exhibition of Fungi and other botanical objects will be held at the "Roebuck" rooms, under the superintendence of many of our best known botanical members, in connection with a two days' "Fungus Foray" in Epping Forest. The Council has great pleasure in gratefully acknowledging aid in various ways in conducting the field meetings, given by the following gentlemen:—Professor Boulger, Mr. J. Britten, Mr. Alfred Fowell Buxton, Mr. W. Cole, Dr. Cooke, Lieutenant Croft, Mr. J. English, Mr. H. Groves, Mr. E. M. Holmes, Mr. T. V. Holmes, Mr. D. Houston, Mr. J. W. Kemsley, Mr. R. Meldola, Mr. J. Parish, Rev. A. Pyne, Mr.

Redington, Mr. W. W. Reeves, Mr. Worthington Smith, Dr. Spurrell, Rev. R. P. Walter, Mr. H. Walker, Dr. Wharton, and Mr. W. Winter. The Council also again has pleasure in thanking the Editors of the 'Essex Times,' 'Chelmsford Chronicle,' 'Essex Weekly News,' and other local newspapers, for kind aid afforded in giving wide publicity to the operations of the Club.

Loughton Camp.—During the summer some surveying work, &c., was done to complete the report on this earthwork by the Secretaries and Mr. H. A. Cole, Mr. D'Oyley being unwell. The report was read at the Southport Meeting of the British Association for the Advancement of Science by Mr. Meldola, some large diagrams being drawn for the occasion by Mr. H. A. Cole. The Council of the British Association has very kindly allowed the Club to use the two lithographic plates, at the cost of printing and paper, for the 'Transactions.' The report will appear in full in part 8 of the 'Transactions,' and also in the forthcoming volume of the 'Reports of the British Association for the Advancement of Science.' The surplus of the "Camp Fund" the Council proposes to add to the "Denehole Exploration Fund," now being formed.

Denehole Explorations.—A Committee has been formed to conduct these explorations, as advised in the last Annual Report, and will commence active work early in the ensuing summer. About £60 is now in hand or promised, but a very much larger sum will be required. A circular will shortly be issued giving names of the members of the Committee, proposed plan of action, list of donations, &c., and soliciting subscriptions from members of the Club and the scientific public. Meanwhile, contributions to the Fund will gladly be received by the Treasurer, or by any of the Committee.

Pre-historic Remains in Essex.—A Committee has been formed to catalogue and survey the relics of pre-historic occupation still existing in the County (Camps, Entrenchments, Tumuli, Palæolithic and Neolithic stations, &c.), in accordance with the suggestions contained in Mr. Meldola's paper, read before the British Association at Southport, and at a recent meeting of the Club, and lately published in 'Nature.' A detailed statement of the information required by the Committee will in due course be largely circulated among the residents in the county.

Epping Forest Railway and the Protection of Wild Animals and Plants.—The vigorous and successful opposition offered to the railway proposed to be made from Chingford to High Beach, in which the Club took a very active and responsible part, has been so fully commented upon in the pamphlet recently issued by the Club that no further remarks are called for in this place. Copies of the pamphlet have been widely circulated, and may be obtained from the Librarian. The Council trusts that Sir Fowell Buxton's scheme for protecting wild animals and birds within the Forest districts will be largely acted upon. The Club will always be glad to give any aid in furthering such views, which so strongly appeal to the instincts of all true lovers of Nature. It is a

matter for regret that the Club was left to bear nearly the whole expense of the public opposition to the High Beach Railway: a charge which largely added to our expenditure during the past year. The only subscription received towards defraying the cost of a work which was really undertaken in the interests of the public generally was £3 3s.—generously given by Mr. D. J. Morgan, one of the Verderers of the Forest.

In conclusion, the Council feels very hopeful of the future success of the Club; but it must always be remembered that the prosperity and usefulness of a Society of this kind is very much in the hands of the members themselves. It is in their power to place the monetary affairs of the Club on a higher level, and so enable the Council to publish more fully and frequently. Almost every member can add to the interest of the meetings by sending specimens for exhibition; reporting the occurrence of rare birds, animals, and plants; the exposure of interesting geological sections by railway and sewerage operations, &c.; by sending short notes on matters of local or scientific interest; and by aiding the officers in planning and carrying out field meetings. The Club should be looked upon as the "Scientific Registry Office" for the county. The remarks made by Mr. Crisp, the Hon. Secretary to the Royal Microscopical Society, at a meeting some years back, are so pertinent, that they may be quoted as a motto for the guidance of our friends during the coming session. Mr. Crisp said:—"I wish to point out that the prosperity of a Society cannot be allowed to depend on the energy or enthusiasm of any one man or set of men. Unless all co-operate, it is inevitable that the Society will in time languish, and I would therefore make an earnest appeal to all not to let any year go by without being able to say that they have contributed *something* to the advancement of the interests of the Society. I venture to think that, in regard to subscriptions to scientific societies, there is too great a tendency to consider the payment of the subscription as the whole duty to be performed, and that it then only remains to watch and see that someone else returns value for the money. It is obvious, however, when once the matter is stated, that this is a wrong notion, and that the association of persons in a scientific society ought to depend upon a very different tie to that of a pecuniary one merely, the subscription being really only the *minimum* contribution which it is necessary to insist that all the members should make."

[The Council has again much pleasure in thanking those members who have kindly furnished the means for serving tea and light refreshments at the Conversazioni held after each ordinary meeting. The contributions amounted to £4 0s. 5d. (including a balance of £1 1s. 5d. from 1882), and the expenses of tea, attendance, &c., at eight meetings to £2 14s. 2d., leaving a balance of £1 6s. 3d. to be carried forward.]

ADDITIONS TO THE LIBRARY.

(*March, 1883, to January, 1884.*)

Anon. A List of British Birds. The Genera arranged according to Sundevall's method. Small 8vo. London, 1877. [*From Mr. W. White.*]

———. A new and complete History of Essex from a late Survey; compared with the most celebrated Historians. 6 vols. 8vo. Chelmsford, 1769—72. [*From Mr. H. Walker.*]

———. Bees. (*Nat. Lib., Entomology, vol. vi.*) 12mo. Edinburgh, 1840. [*From Mr. W. H. Gomm.*]

———. Sydenham, Dulwich, and Norwood: A Handy Guide to Rambles in the District. 8vo. London, n.d. [*From Mr. T. F. Unwin.*]

———. Wimbledon, Putney, and Barnes: A Handy Guide to Rambles in the District. 8vo. London, n.d. [*From Mr. T. F. Unwin.*]

Antiquarian Magazine and Bibliographer. Vols. iii., iv. 8vo. London, 1883. [*From the Publisher.*]

Botany, Journal of. New series. Vol. xii. 8vo. London, 1883. [*From Mr. R. L. Barnes.*]

British Ornithologists' Union. A List of British Birds, compiled by a Committee of the B. O. U. 8vo. London, 1883. [*From Dr. H. T. Wharton.*]

Cambridge Philosophical Society. Proceedings. Vol. iv. 8vo. Cambridge, 1883. [*From the Society.*]

Clarke, Louisa L. The Common Sea-weeds of the British Coast and Channel Islands. Small 8vo. London [1865]. [*From Mr. W. White.*]

Conchology, Journal of. Vol. iii. 8vo. London, 1880—82. [*From the Editor.*]

Derbyshire Archæological and Natural History Society. Journal. Vols. i.—vi. 8vo. London and Derby, 1879—84. [*From the Society.*]

Dorset Natural History and Antiquarian Field Club. Proceedings. Vol. iv. 8vo. Sherborne, n.d. [*From the Society.*]

[D'Oyley, William.] Epping Forest. Reduced copies of the Forest marks, with the names of Reeves and Assistant Reeves of the several Forest Parishes. Small 8vo. London, 1880. [*From the Author.*]

Duncan, James. Foreign Butterflies. (*Nat. Lib., Entomology, vol. v.*) 12mo. Edinburgh, 1837. [*From Mr. W. H. Gomm.*]

Entomological Society. Proceedings. 1833—70. 6 vols. 8vo. London. [*From the Society.*]

Entomologist. Vol. xvi. 8vo. London, 1883. [*From Mr. P. F. Copland.*]

Entomologist's Monthly Magazine. Vol. xix. 8vo. London, 1883. [*From Mr. B. G. Cole.*]

Essex Institute. Bulletin. Vol. xiv. 8vo. Salem, Mass., 1883. [*From the Society.*]

Essex, Post Office Directory of. 8vo. London, 1882. [*Purchased.*]

Geological and Natural History Repertory, and Journal of Prehistoric Archæology and Ethnology. 1865—67. 8vo. London, 1867. [*From Mr. W. White.*]

Geologists' Association. Proceedings. Vols. vi., vii. 8vo. London, 1881—83. [*From the Society.*]

Glasgow, Philosophical Society of. Proceedings. Vol. xiv. 8vo. Glasgow, 1883. [*From the Society.*]

Grevillea: A Quarterly Record of Cryptogamic Botany, and its Literature. Vol. xi. 8vo. London, 1882—83. [*From the Editor.*]

Jardine, Sir W. Birds of Prey. (*Nat. Lib., Ornithology, vol. ix.*) 12mo. Edinburgh, 1838. [*From Mr. W. H. Gomm.*]

———. Humming Birds. 2 vols. (*Nat. Lib., Ornithology, vols. i., ii.*) 12mo. Edinburgh, 1833. [*From Mr. W. H. Gomm.*]

[Johnston, Andrew.] Suggestions to Lay Justices on the Study of the Law of Evidence, as it affects their Duties. 8vo. London, 1883. [*From the Author.*]

Land and Water. [*From Mr. R. Meldola.*]

Liverpool, Literary and Philosophical Society of. Proceedings. Vols. xxxv.—xxxvii. 8vo. London and Liverpool, 1881—83. [*From the Society.*]

Midland Naturalist. Vol. vi. 8vo. London, 1883. [*From Mr. A. Lockyer.*]

Natural History Notes. Vols. i., ii. 8vo. Vol. iii. 4to. London, 1881—83. [*From Mr. R. Meldola.*]

Naturalist. New series. Vol. viii. 8vo. Huddersfield, 1883. [*From the Editors.*]

Nature. Vols. xxvii., xxviii. Large 8vo. London, 1883. [*From Mr. H. J. Barnes.*]

Northampton Natural History Society. Journal. Vol. ii. 8vo. Northampton, 1882—83. [*From the Society.*]

Observatory, The: A Monthly Record of Astronomy. Vols. v., vi. 8vo. London, 1882—83. [*From the Editor.*]

Ormerod, Miss. Guide to Methods of Insect Life; and Prevention and Remedy of Insect Ravages. 8vo. London, 1884. [*From the Authoress.*]

Pritchard, Andrew. Notes on Aquatic Microscopic Subjects of Natural History. 12mo. London, 1854. [*From Mrs. Yeates.*]

Ray, John. Historia Insectorum. Opus Posthumum Jussu Regiæ Societatis Londinensis Editum. Small 4to. London, 1710. [*From Mr. E. A. Fitch.*]

Royal Microscopical Society. Journal. Second series. Vol. iii. 8vo. London, 1883. (Two copies.) [*From Mr. W. Emmens and the Society.*]

Science Gossip. Vol. xix. 8vo. London, 1883. [*From Miss Cole.*]

Shropshire Archæological and Natural History Society. Transactions. Vols. v., vi. 8vo. Shrewsbury, 1882—83. [*From the Society.*]

Somersetshire Archæological and Natural History Society. Proceedings. New series. Vol. viii. 8vo. Taunton, 1883. [*From the Society.*]

Swainson, William. Flycatchers. (*Nat. Lib., Ornithology, vol. x.*) 12mo. Edinburgh, 1838. [*From Mr. W. H. Gomm.*]

Yorkshire Geological and Polytechnic Society. Proceedings. Vols. vi., vii. 8vo. Leeds, 1879—82. [*From the Society.*]

Zoologist. Third series. Vol. vii. 8vo. London, 1883. [*From Mr. R. L. Barnes.*]

Pamphlets. Vol. v. Zoology. 8vo.

Contents:

Anon. Birds of the Montrose District. Montrose, 1881.

Cole, W. On a Parasite of Humble Bees. (*Journ. Quekett Micros. Club*, 1875.)

Fitch, E. A. The Galls of Essex. (*Trans. Essex Field Club*, 1882).

Gloyne, C. P. On the Geographical Distribution of the Terrestrial Mollusca. (*Quart. Journ. Conchol.*, 1877.)

Harting, J. E. Extinct British Quadrupeds. (*Zool.*, 1881.)

———. Forest Animals. (*Trans. Essex Field Club*, 1881.)

———. Hertfordshire Deer Parks. (*Trans. Herts. Nat. Hist. Soc.*, 1883.)

Kent, W. S. Infusoria: What are they? Their Collection and Investigation. (*Trans. Essex Field Club*, 1882.)

Laver, H. On the Land and Fresh-water Mollusca of the District around Colchester. (*Ib.*)

———. The Mammalia of Essex. (*Ib.*)

Meldola, R. Entomological Notes bearing on Evolution. (*Ann. & Mag. Nat. Hist.*, 1878.)

———. The Developmental Characters of the Larvæ of the Noctuæ as determining the Position of that Group. (*Trans. Essex Field Club*, 1881.)

Newport, G. On the Anatomy, Habits and Economy of *Athalia centifoliæ*. London, 1838.

Ormerod, E. A. A Lecture on Injurious Insects. Cirencester, 1881.

———. On "Cane-borers." (*Proc. Ent. Soc.*, 1880.)

———. On the Cutaneous Exudation of *Triton cristatus*. (*Journ. Linn. Soc., Zool.*)

Raynor, G. H. The Macro-Lepidoptera of the District around Maldon. (*Trans. Essex Field Club*, 1883.)

Taylor, J. W. Life History of *Helix arbustorum*. (*Journ. Conchol.*, 1881.)

[Wallace, A. R.] Mimicry and other Protective Resemblances among Animals. (*Westminster Rev.*, 1867.)

White, W. Is *Vanessa polychloros* the prototype of *V. urticæ*? (*Trans. Essex Field Club*, 1881.)

Pamphlets. Vol. vi. Miscellaneous. 8vo.

Contents:

Allman, G. J. Address [to the British Association]. (*Rep. Brit. Assoc.*, 1879.)

Brady, Sir A. Address [to the Sanitary Congress]. Exeter, 1880.

Cole, W. Preliminary Report of the Committee appointed to investigate the Loughton Camp. (*Rep. Brit. Assoc.*, 1882.)

——— and Others. Papers and Memorials on the Protection of wild Animals and Plants, and the present condition and future management of Epping Forest. (*Trans. Essex Field Club*, 1883.)

Corder, H. Stone and Bronze Implements from the neighbourhood of Chelmsford. (*Ib.*, 1881.)

English, J. The First Night's "Sugaring" in England. (*Ib.*)

Harting, J. E. On the Formation of a Local Museum. (*Ib.*)

Holmes, T. V. On Deneholes. (*Ib.*, 1883.)

——— and Others. Report of the Committee for the Exploration of the Subsidences on Blackheath. Blackheath, 1881.

Lubbock, Sir J. Address [to the British Association]. (*Rep. Brit. Assoc.*, 1881.)

———. On a Stone Implement of Palæolithic Type found in Algeria. (*Journ. Anthrop. Inst.*, 1881.)

Meldola, R. Darwin and Modern Evolution. (*Trans. Essex Field Club*, 1883.)

———. Inaugural Address to the Essex Field Club. (*Ib.*, 1880.)

———. Presidential Address to the Essex Field Club. (*Ib.*, 1882.)

Pitt-Rivers, A. Report on the Excavation of Ambresbury Banks. (*Ib.*, 1881.)

Smith, W. G. Primæval Man in the Valley of the Sea. (*Ib.*, 1883.)

Sparvel-Bayly, J. A. Hadleigh Castle, Essex. (*Trans. Essex Archæol. Soc.*)

———. Roman Billericay. (*Ib.*)

Spurrell, F. C. J. Palæolithic Implements found in West Kent. (*Archæologia Cantiana*, 1883.)

[Walker, H.] Excursion to Riddlesdown. (*Proc. W. London Sci. Assoc.*, 1876.)

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ERRATUM IN THIS PART.—Page 157, *note*, line 3 from bottom, *for* "*Euporbiæ*," *read* "*Euphorbiæ*."

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